LiBackpack C50

Mobile Handheld 3D Mapping System
User Guide

GreenValley International

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Copyright

1. Safety Warning

Please read this user guide carefully before you use the product and follow all operating and use instructions. The manual will be updated from time to time as the product upgrades. To access the latest user guides for LiBackpack C50, go to the official website of Greenvalley International or contact a GVI Tech Support Specialist.

LiBackpack C50 is an extremely high-precision device and is sensitive to jolts and excessive vibration. Please be careful when using the product. Please secure it in its protective case when carrying the scanner,

Note: If the scanner is not used for an extended period, please remove the battery from it.

Please also note that the warranty will become invalid if you dismantle and/or reassemble any LiBackpack devices without instructions from our official support team. This product should be serviced by a qualified licensed technician, electrician or electrical maintenance personnel farmiliar with its operation and the hazards involved.

2. Introduction

LiBackpack C50 is a mobile backpack/handheld LiDAR 3D mapping system to collect indoor and outdoor point cloud and panoramic photography with high precision. It integrates LiDAR and panoramic photography with SLAM (Simultaneous Localization and Mapping) technology to acquire point cloud data with true color texture information.

The LiDAR point cloud data acquired using LiBackpack C50 can be applied in many fields and industries such as integrated indoor and outdoor measurement, underground space data acquisition, tunnel engineering, digital factory, digital mining, forest inventory, and building information modeling.

2.1 Product Name

Product Name: LiBackpack C50 Mobile Backpack 3D Mapping System

2.2 Technical Specifications

Laser Sensor	Velodyne VLP-16
Laser Classification	Class 1 Eye-Safe
Range Accuracy	±3cm
System Relative Accuracy	3cm*
System Absolute Accuracy	5cm*
Weight	7.1kg
Main Dimensions	770*320*190mm
Max Range	100m
Wavelength	903nm
Scan Rate	300000pts/s
Horizontal FOV	0°~360°
Vertical FOV	-15°~15°
POS System	Integrated SLAM System
Point Cloud Data Format	.las,.laz,.ply,.LiData
Storage Space	512GB
Ports Available	HDMI,USB, Ethernet
Battery Capacity	5700mAh*2
Operating Time	≥2h
Operating Temperature	-10℃~40℃
Max. Ground Speed	20km/h
Camera Type	Panoramic
Camera Resolution	3840*1920
Camera Refresh Rate (fps)	30fps
Control and Display	UI on mobile devices via Wi-Fi (smartphones and tablets) or data cable (tablets)

*Affected by scanning route and environment.

3. Compose

LiBackpack C50

1. Protection for laser scanner
2. Battery charger and power cable
3. Battery (not included)
4. Scanner arm, laser scanner, and panoramic camera
5. LiBackpack C50 storage control unit
6. Control point accessories
7. Main connection line
8. LiBackpack C50 Wired Line
9. Surface tablet
10. Surface charger
11. LiBackpack C50 camera data cable
12. USB disk

Optional: IPad Mini Tablet

LiBackpack C50 Product Details

Panoramic Camera

Laser Scanner

Battery

Ethernet port

HDMI

USB3.0

Battery

Main body PC
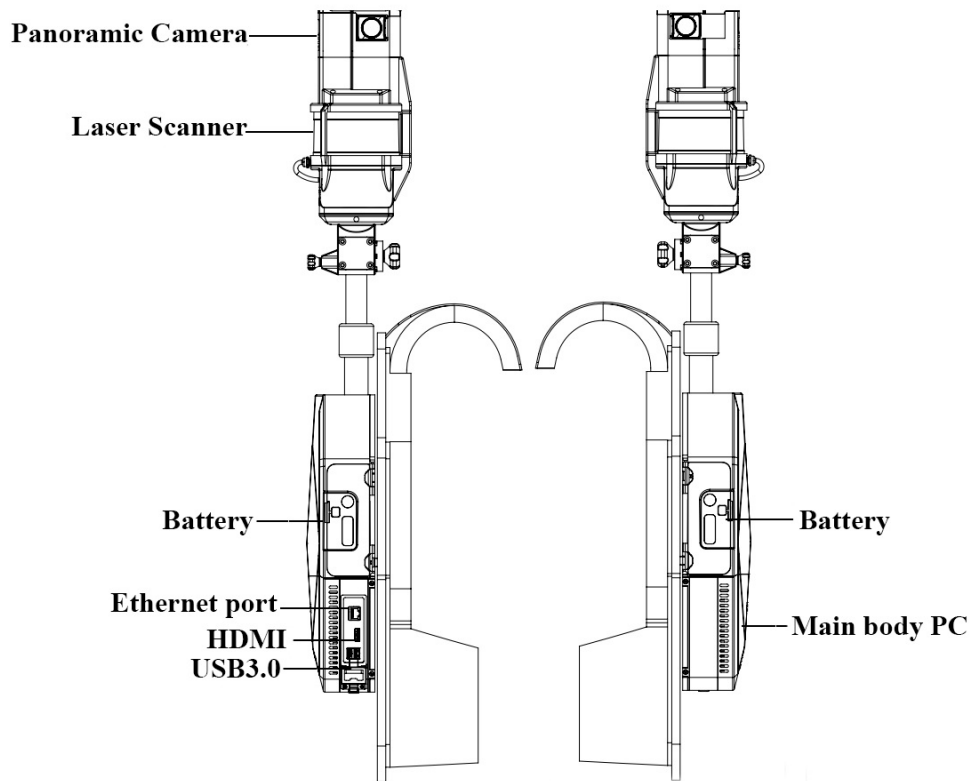
3.1 Laser Scanner

Laser Sensor	Velodyne VLP-16
Max Range	100m
Wavelength	903nm
Scan Rate	300000pts/s
Horizontal FOV	360°
Vertical FOV	±15°
LiDAR Range Accuracy	±3cm
Operating Temperature	-10℃~60℃

3.2 Camera

| Camera Type	Panoramic Camera
Resolution	3840*1920
Refresh Rate	30fps

3.3 PC

- Operating Voltage：19V
- Storage Space: SSD 512GB
- CPU：quad core 8 threads

3.4 Wi-Fi Information

- Frequency range: 2.4 GHz

- Protocol：IEEE 802.11n
- Security：WPA2-Personal
- Gateway address：192.168.12.1
- Connections allowed：1 device
- Connection range：5m
- Wifi SSID: LiBackpack(default password：greenvalley)
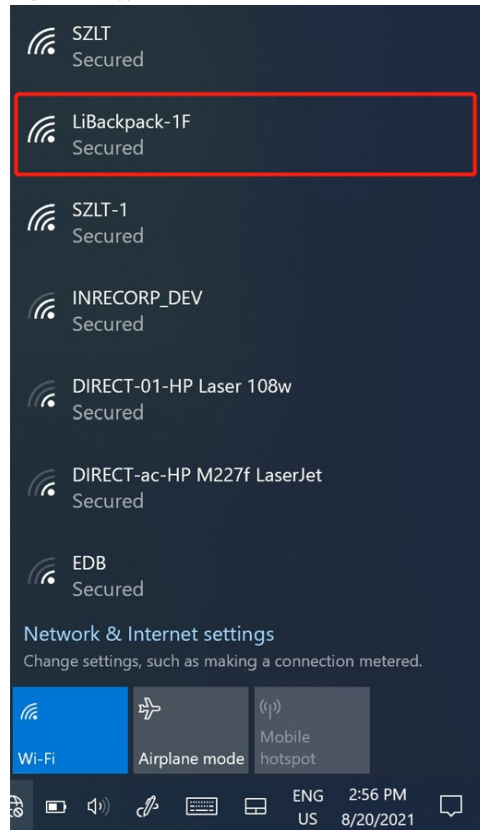
LiBackpack Wifi information

4. Setup

LiBackpack C50 supports Backpack Scanning Mode for data collection.

STEP 1. Place LiBackpack C50 Main Body and Scanner Arm on a suitable work surface.

LiBackpack C50 Main Body and Scanner Arm

STEP 2. Insert the Scanner Arm into the Main Body.

Alignment and Mold Lock-up

STEP 3. Tighten the screw. You will hear a click sound from the lock after the lock-up when the two parts cannot be separated. Tighten the screw to make sure that the scanner arm is securely attached to the Main Body.

Tighten the screw.

STEP 4. Rotate the lock ring of the telescopic lever counterclockwise so that the telescoping poles can be extended or retracted smoothly.

Loosen the lock ring

STEP 5. Hold the bottom of the lock ring with your left hand, grip the bottom of the Scanner Arm with your right hand and extend it upwards.

Extend the Scanner Arm

STEP 6. While the right hand holding the bottom of the Scanner Arm, use your left hand to tighten the left lock ring clockwise, and then tighten the right lock ring.

Tighten the lock rings

STEP 7. Insert one end of the handheld cable to the Scanner Arm Align the red dot on one end of the Handheld Cable with the one on the Scanner Arm and then insert. Align the red dot on the other end of the Handheld Cable with the red dot on the Main Body and insert.

EMO push-pull connector

STEP 8. Fully Set Up for Backpack Scanning Mode

Fully Set Up

5. Workflow

Please follow the following instructions strictly to ensure normal operations of the system.

5.1 Prepare for Acquisition

Making plans for the acquisition routes can help improve the quality and accuracy of data collection. See section 6.2 Route Planning for advice on the topic.

5.2 Initialize the System

Remove the Battery Compartment Cover and insert a charged Battery. Press and release the round button on the Battery. Press and hold for 2 seconds until the red indicator light stays on to show the Battery is on. Meanwhile, both Laser Scanner and the Main Body will start working and the laser scanner will vibrate gently.To turn off the battery and the device, repeat this procedure.

Turn On the Battery

Short-press the camera button and you will hear a short beep, indicating the camera is switched on and the camera information will appear on LiBackpack interface.

Turn on the Camera

After the initialization process for the system, the indicator light (RUN) will stay on when LiBackpack C50 is on.

Indicator Light Status

> Note: Wait for one minute before connecting a mobile device (smart phone or IPad) to LiBackpack's Web-Browser Based User Interface through Wi-Fi or cable.

Connecting to the LiBackpack User Interface via Wi-Fi:

- From the list of networks available to your device select the network named "LiBackpack".
- When prompted to do so, enter the default password "greenvalley".
- Launch Google Chrome or Safari and navigate to 192.168.12.1 and load the LiBackpack User Interface. (If the User Interface fails to load, please go check whether Wifi is connected to LiBackpack.)
- Users using the recommended tablets can open up the UI straight from the desktop shortcut.

Connecting to the LiBackpack User Interface via Ethernet Network:

- Connect LiBackpack and the tablet with the LiBackpack C50 Ethernet Cable.
- Navigate to the Network settings on the tablet. Set the IP address and subnet mask to the following values:
- IP address: 192.168.1.99
- subnet mask: 255.255.255.0
- Launch Google Chrome or Safari and navigate to http://192.168.1.200 to load the LiBackpack User Interface.

> Note: The current system supports UI through Chrome and Safari.

Successfully connected Mobile UI is shown as follows.
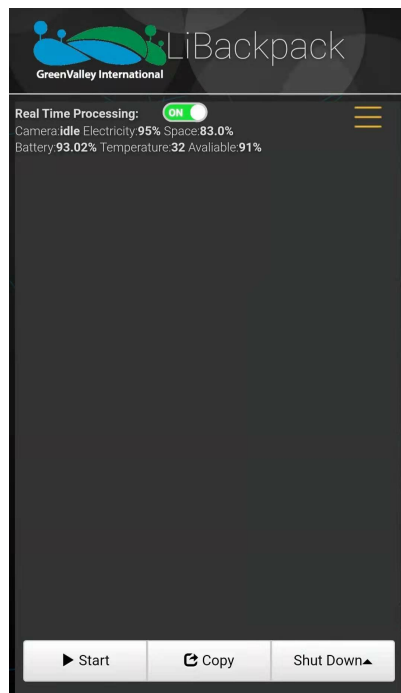
Mobile UI

5.3 Start Scanning

Power ON Laser Scanner by pressing the Laser Scanner On/Off Button once. The red indicator light surrounding Laser Scanner On/Off Button will illuminate and the laser scanner will vibrate gently. Make LiBackpack C50 balance in the horizontal position.

Click on the Start button in the lower left corner of the browser-based LiBackpack user interface. Once point cloud in the display, please walk in the "8" pattern which will take about 1 minute before you start collecting data following planned routes.

Please note that each scanning session is restricted under 20 minutes, otherwise the camera would be overloaded with data which may result in unstable performance.

Please wait until the camera status is idle before moving to the next steps.
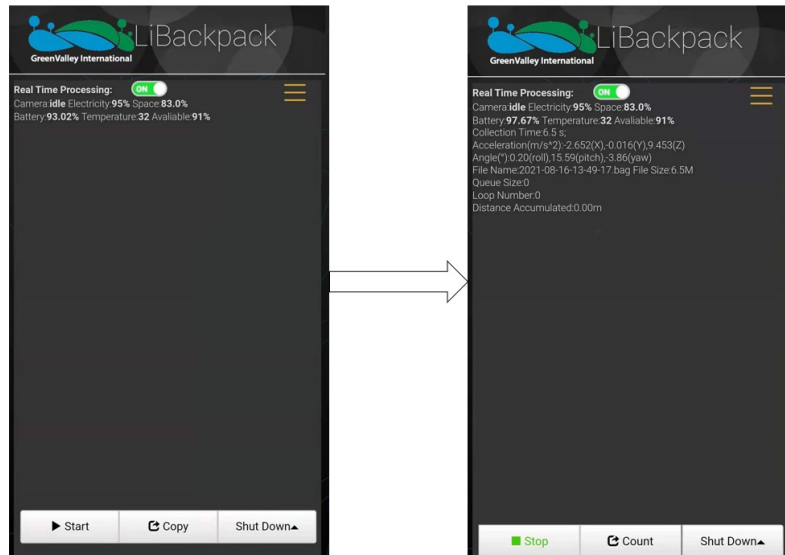
Start Scanning

5.4 Acquire Data

As the LiBackpack begins acquiring data, the Main Viewer of the web-based UI will display a sparse 3D point cloud constructed in real-time by GVI's technology. Some system status and acquisition information will display in the upper left corner of the UI, including:

Camera Status

- **Camera**: OFF/idle/recording:
- **OFF**: camera is turned off
- **Idle**: camera is turned on and ready for recording
- **Recording**: camera is recording
- **Electricity**: camera battery charge;
- **Space**：Camera storage space;

Device Status

- **Battery**：Remaining battery power.
- **Temperature**：Temperature of main computer.
- **Avaliable**：Avaliable space of main computer.

Acquisition Information

- **Real Time Processing**：The switch to control the real time processing. If this option is on, the device will process the data in real time and export the trajectory file and the result point cloud; if this option is off, the device will not process the data and will not export the trajectory file or the result point cloud.
- **Collection Time (s)**：data acquisition time
- **Acceleration(m/s^2)**：IMU acceleration
- **Angle(°)**：roll、pitch、yaw
- **File Name**：name of current .bag file
- **File Size**：size of current .bag file
- **Queue Size**：point cloud frame latency
- **Loop Number**：current loops closed
- **Distance Accumulated (m)**：current distance covered
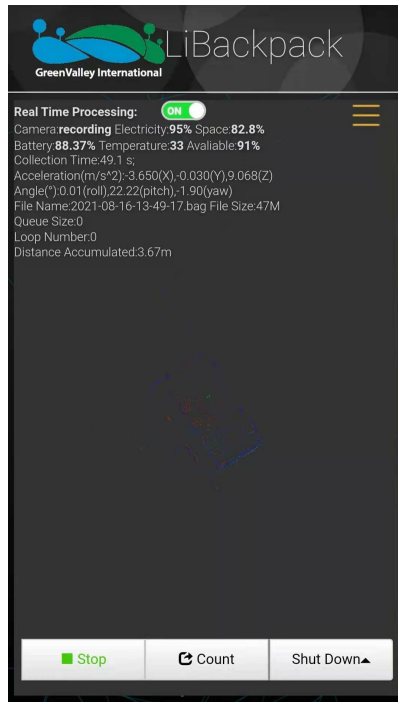
Scanning Data

When the data acquisition process is done, please walk in the "8" pattern again which will take about 1 minute before you press the **Stop** button below the Main Window and wait for the countdown. The data acquisition process is completed when the countdown window closes.

Once the session is over, turn off the camera and the scanner. Then turn off the main system PC from the UI.
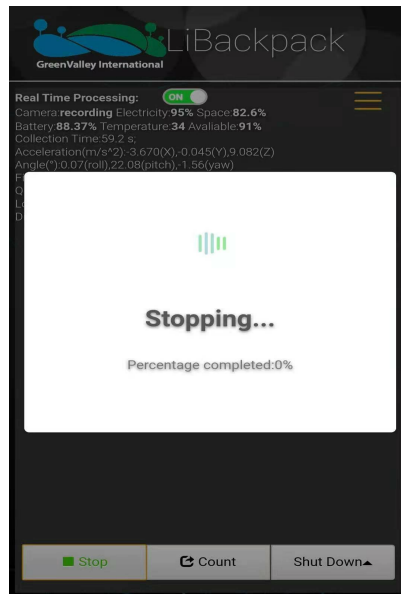
Stop Scanning

Note: Press **Reboot** button at the bottom of the window and you can restart your computer, or click on **Shut Down** button to turn it off.
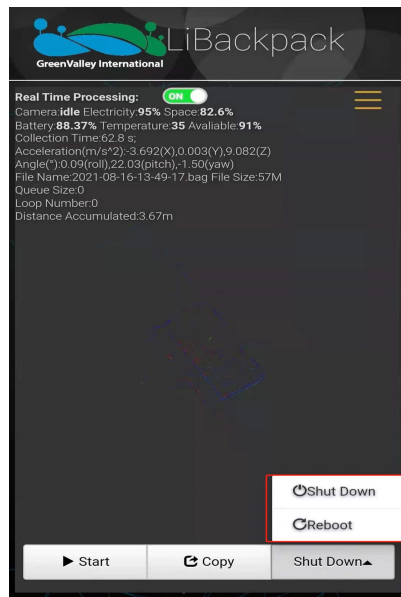
Shut down the mainframe

5.5 Export Data

5.5.1 Export Point Cloud Data

1.USB flash disk transmission:Insert a USB storage device into the USB ports. Click the **Copy** Button below the Main Window of the web-based UI. Select the .ply and .bag files to be transferred to the USB storage device. Details of data transfer will be displayed in the dynamic status bar, including the number of files being passed to the external storage device, the total size and speed of the data being transferred. The total and spare storage space of system and USB are also displayed there.
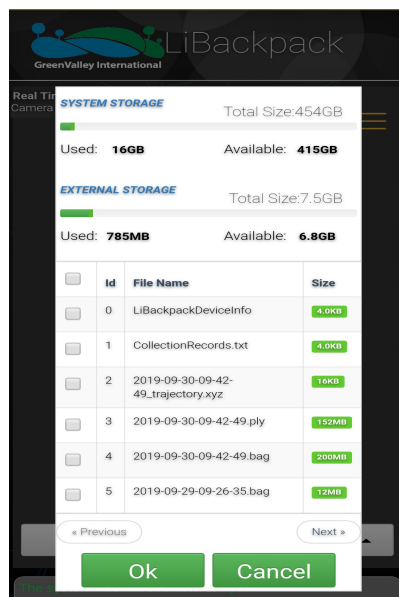
Copy Data

When the data copy process is done, the message bar will prompt "Copy is completed!" and a dialog box saying "Completed!" will pop up. Click the OK button and unplug the USB storage device.

> Note: When large amounts of data are transferred from the LiBackpack to an external storage device, the progress bar may stay at 99% for a long time. Wait until the dialog box pops up indicating that the file transfer has completed before unplug USB to prevent from data corruption.
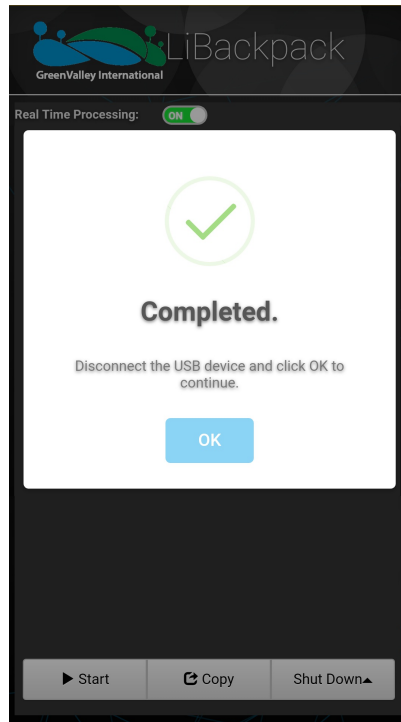
Unplug the USB drive

2.Data cable transmission: When the device is turned on, connect one end of the network cable to the device and the other end to the computer, and set the computer **"IP address: 192.168.1.99, subnet mask: 255.255.255.0"**,Enter the URL **"\\192.168.1.200"** at the computer network, enter the internal storage space of the device, open the **"share"** folder, and select the collected .ply files, .bag files according to the collection time, copy it to the computer, and then complete the data export.
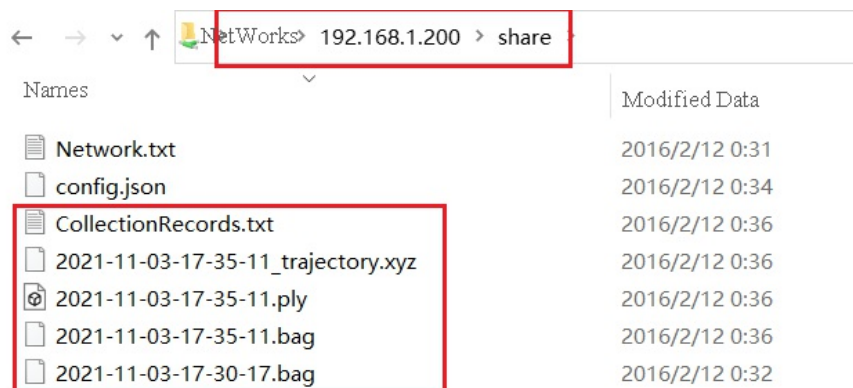
Data Export

> The first time you enter the **"share"** folder, you will generally be prompted to enter the user name and password: **"User name: share, password: 111111"**

5.5.2 Export Imagery Data

1.Copy CollectionRecords.txt with .bag file, and it records the corresponding camera file name to .bag.

2.When transferring camera data, make sure that camera is on. Use a USB cable to connect the camera to the computer, and copy camera file. To leave the Lidar on/off would not affect imagery data export.

> Note:
>
> - The data format recorded in CollectionRecords.txt is .mp4. And there is no need to consider the difference of the suffix name when copying the video corresponding to the .bag file
> - Recording 4k video and you will get a .mp4 or .insv file, while recording 5.7k video and you will get two .mp4 or .insv file.
> - Make sure to the disk space is large enough for the data file.
> - Please free up camera storage space from time to time in case the data is too large and cause insufficient storage available. Please always check the memory card usage.

3.Video Stitching

Open insta360 studio 2021 software and leave all options in "Settings - Preferences - Codec Settings" unchecked as shown in the following picture
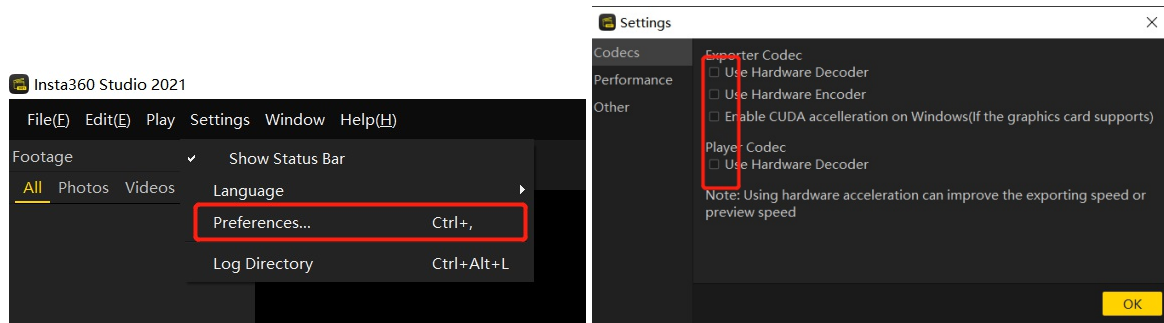

Softeware Preferences

- Change the suffix of the .mp4 file copied in STEP 2 to .insv and drag it into the red frame as shown in the picture. After loading the video, leave "Enable FlowState Anti-shake" unchecked as shown in the red frame in the picture.
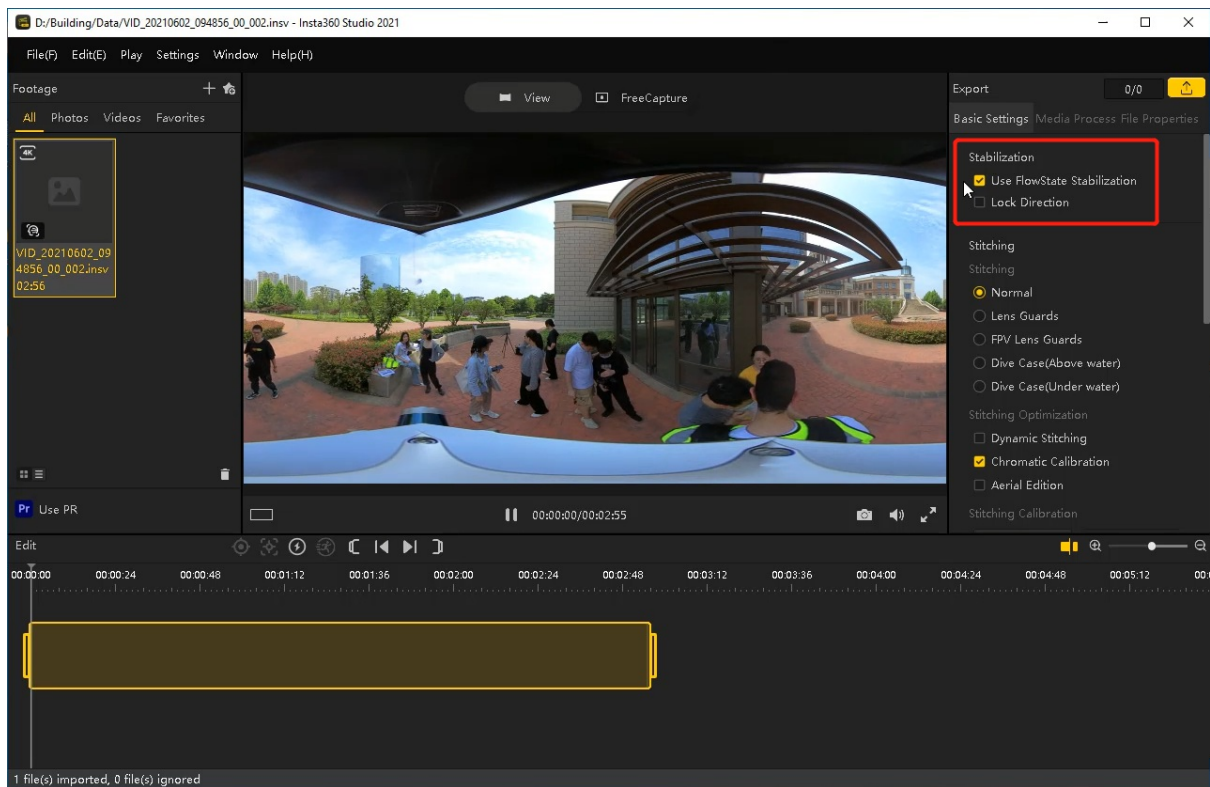

Loading Video

- Click "Export" at the top-right corner of the screen as shown in the picture. Leave the file name within the red frame unchanged and set the export path (it is recommended that the exported .mp4 file be saved in the same directory as the original .insv file). Leave all other parameters default and then click on OK. Wait for some time until the stitching process is complete and a panoramic video is created.
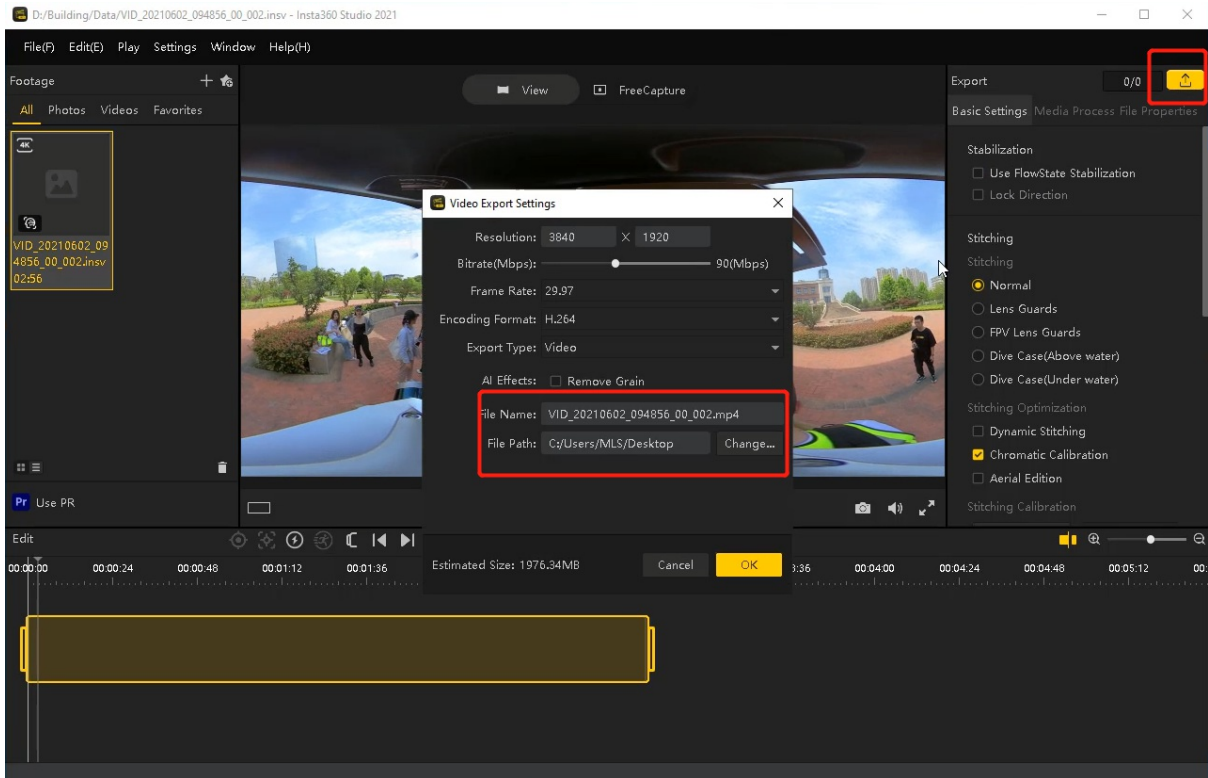
Export Setup
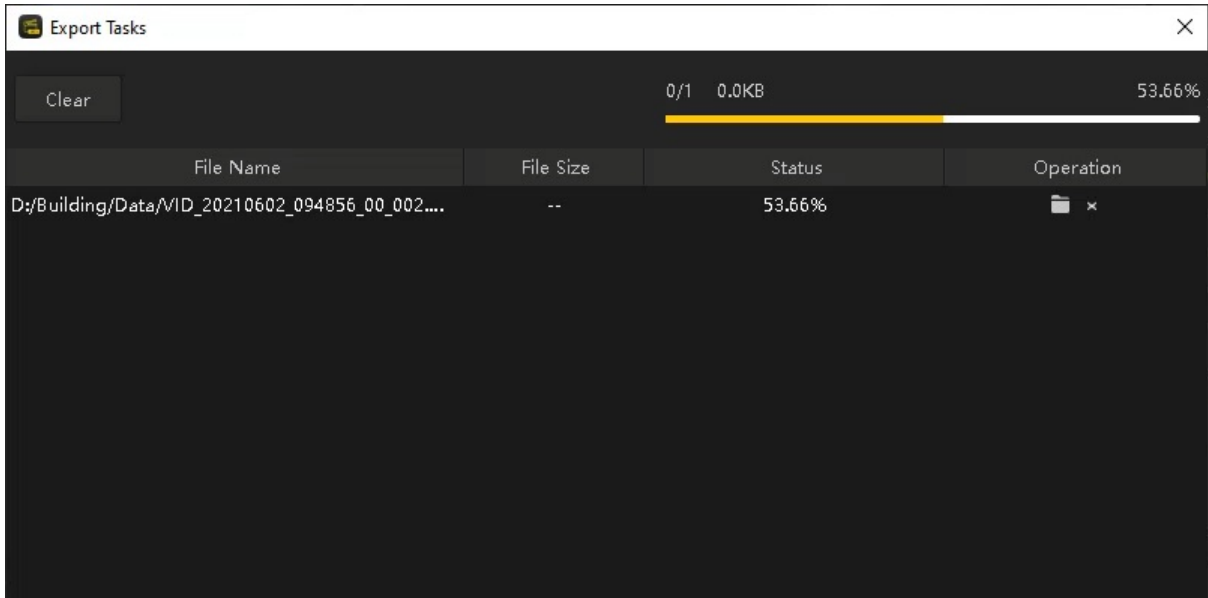
Process Bar

> Note: Please save the .insv file and .mp4 file under the same folder for colorisation.

5.6 File Formats

5.6.1 .bag file

Raw data format. If real-time point data is not quite ideal, you can post-process in LiBackpack-Desktop for enhancement. If the result is still not satisfying, you can send files to GVI for further processing. Please enclose a readme .txt with .bag file to provide following information:

1. Data collection location: xxxxxx;
2. Scanning equipment: LiBackpack C50;
3. Scanning scene description: xxxxxx (e.g., indoor, forest, factory);
4. Purpose of scanning: xxxxxx.

5.6.2 .ply file

Real-time scanning result for data preview.

Naming rules: .ply file is named by the system time when data collection started (e.g., 2018-05-16-17-24-53.ply indicates that data collection started at 2018/05/16 17:24:53).

5.6.3 .xyz file

Trajectory file processed in real time, including relative coordinates.

Naming rules: start time +_trajectory. Each row represents the x, y, z coordinates of a trajectory point. The starting point is the coordinate origin.

> Note: A single data collection will only generate .bag file without real-time point cloud file or trajectory file when real-time process function is off.

5.6.4 CollectionRecords.txt file

For each collecting session, a piece of record will be added to this .txt file, containing the corresponding .bag file name, time of collection, number of closed loops and queue size, accumulated distance etc., as shown on the right picture:
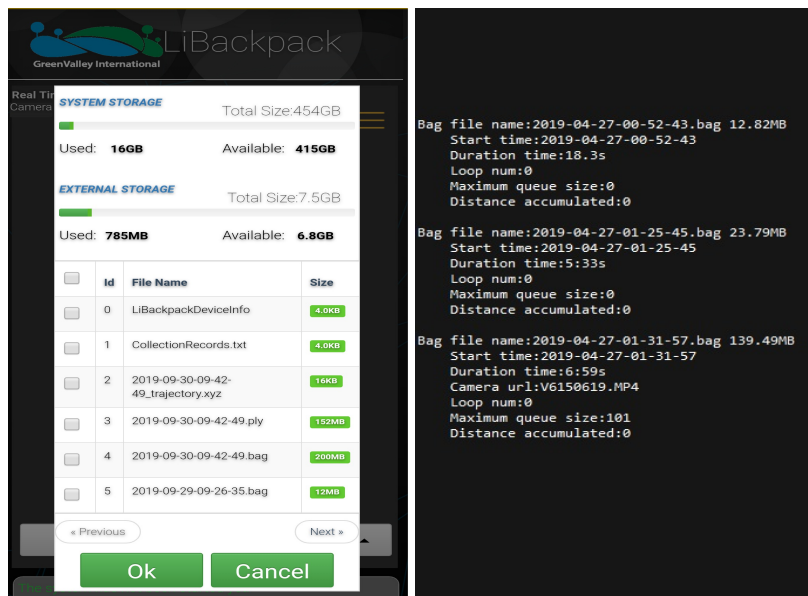
Data Collected by the LiBackpack System

5.6.5 .mp4 file

Raw panoramic video data collected by the camera module. The .mp4 file would go through image processing before being imported to LiFuser-BP for post-processing to generate color point-cloud.

5.7 Preview Point Cloud Data with LiDAR 360

Enable LiDAR360 software, click + on the menu to add point cloud data and click Apply. The following image shows the interface when LiDAR360 opens .ply file. Click Apply all.
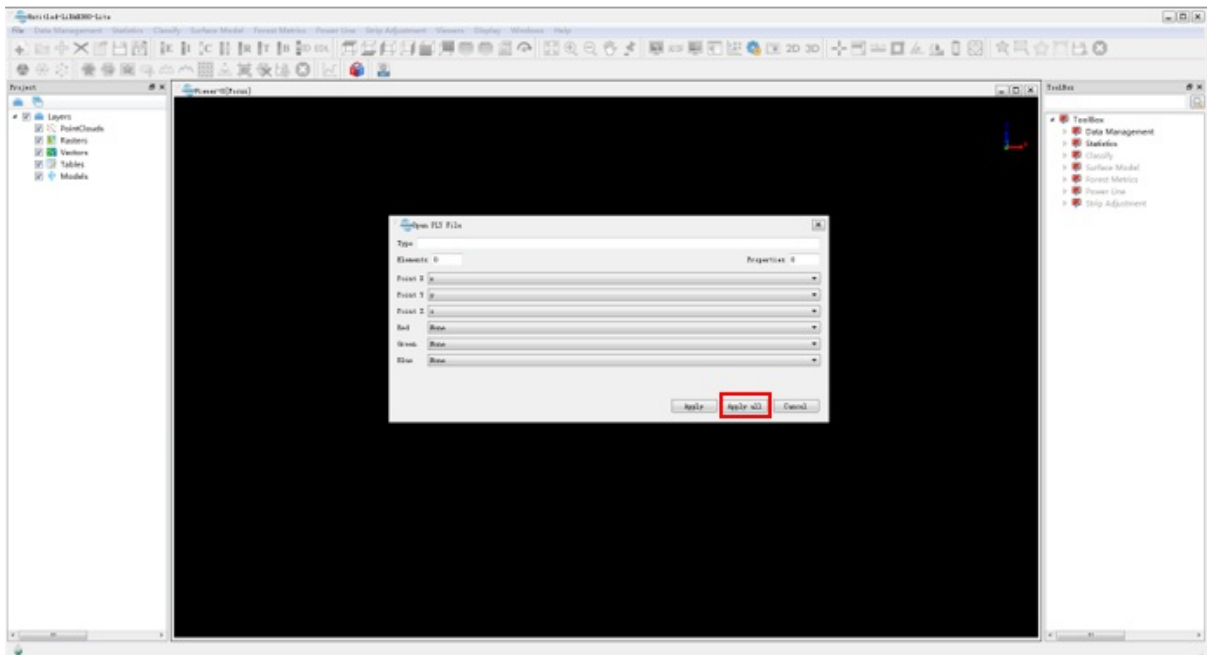
LiDAR360 Loading Data

LiDAR360 software would start to load data. After loading, click EDL in the tool bar of the LiDAR360 window. An Elevation view with EDL is shown as follows.
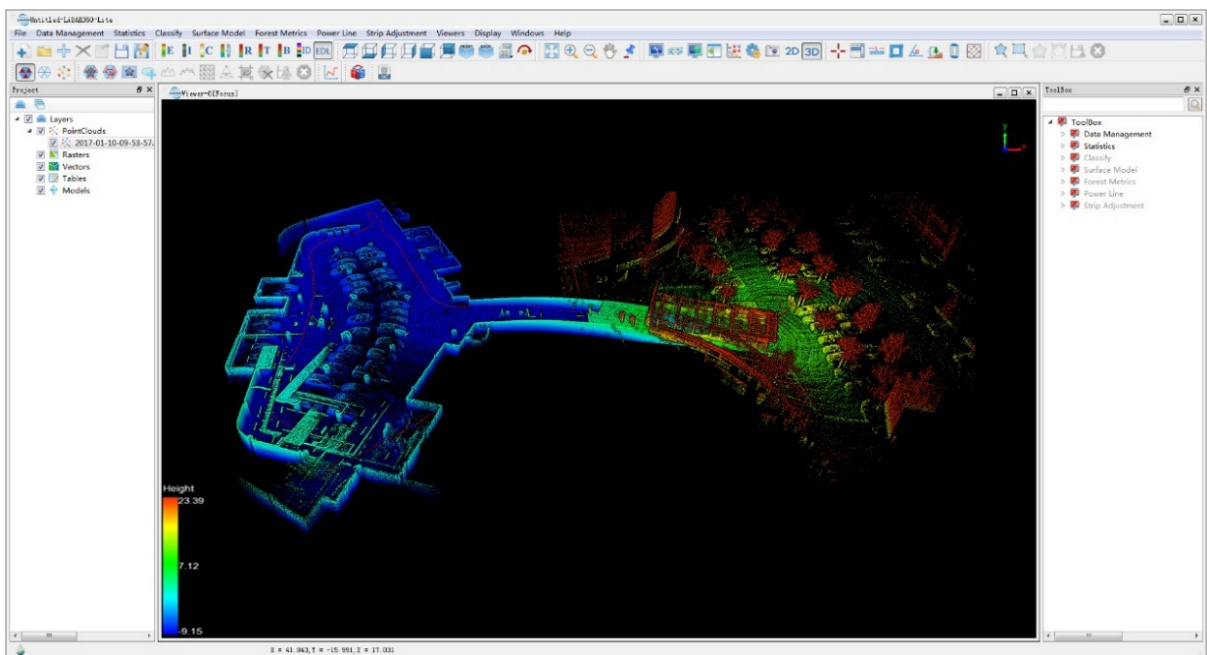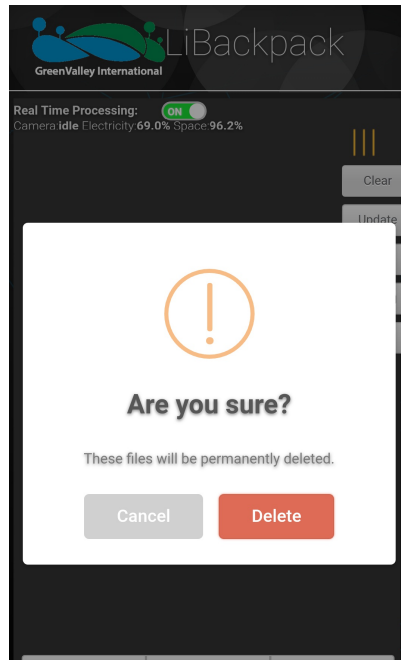

EDL Display Effect

5.8 Extended function

5.8.1 Clean up Data

When system storage space is inadequate (as shown in the Copy interface) and old data is no longer needed, tap on the **Clear** button to clear data from the system.
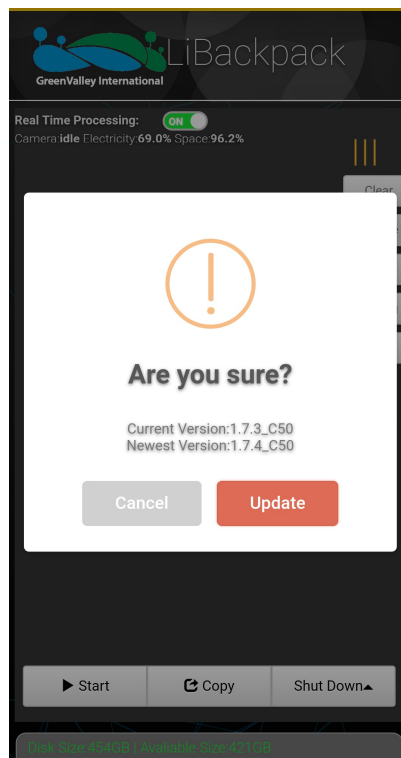
Note: This operation will permanently delete all data from storage.

Clean up Data

5.8.2 System Firmware Upgrade

Firmware upgrades can be realized by USB drive installation. Users can acquire upgrade packages from GVI and place them in the root folder of a USB drive. Tap on the **Upgrade** button. The following interface will tell you about current version.

System Upgrade

Note: If the package is non-existent, placed wrong, or renamed, then the system will not detect and proceed.

5.8.3 System Version Information

Tap on **About** button to check the current firmware version and GVI contact information.
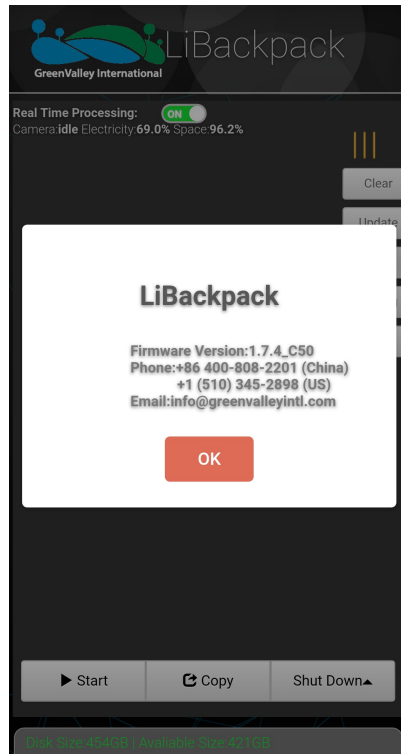
System Version Information

5.8.4 Real-time Processing Parameter Settings

LiBackpack generates point cloud data, .ply file, in real-time processing. Before data acquisition, the parameters for real-time processing can be set in UI Setting. These parameter settings will affect the real-time point cloud data file .ply, but not the raw data .bag. Tap on the **Setting** button on UI interface to view/set the following parameters:

- **Min Points Num**：the minimum number of points in a point cloud frame which will participate in SLAM processing. The default value is 10000. The frames with point cloud number less than this will be considered as a frame with low quality and will be excluded from SLAM processing for 3D point cloud reconstruction. (Note: the excluded frames of point clouds are still preserved in the raw data .bag file, and will be utilized in post-processing.)
- **Max Distance**：the maximum distance from a point to the center of the laser scan which will participate in the real-time SLAM processing. The default value is 70 (meters). The points with further distance to the laser scanner will be excluded from real-time SLAM processing. (Note: the excluded points are preserved in the raw data .bag file.)
- **Min Distance**：the minimum distance from a point to the center of the laser scan which will participate in the real-time SLAM processing. The default value is 1.5 (meters). The points with a distance to the laser scanner shorter than the default value will be excluded from real-time SLAM processing. (Note: the excluded points are preserved in the raw data .bag file)
- **File Name Suffix**：the suffix to be added to the names of the.ply, xyz, and .bag files.

> Note:
>
> 1. Please have parameters set before clicking Start button to start data collection.
> 2. Please only have English character in file suffix.
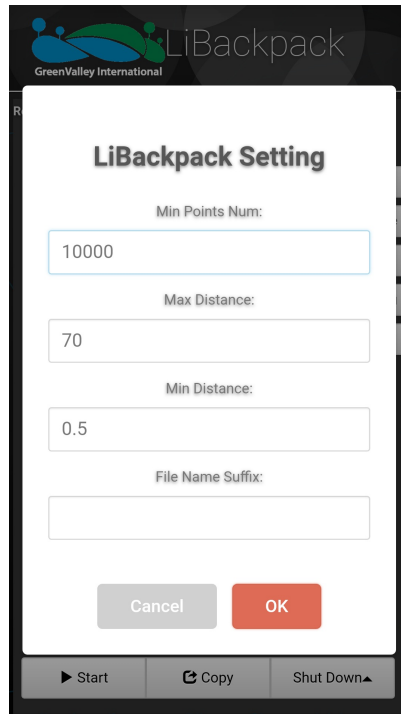
Parameter Settings

5.8.5 Wi-Fi Settings

When not collection data, you can set Wi-Fi name and password by clicking the Wi-Fi Button in the extension menu.

- **Wifi Name Suffix**：The default Wi-Fi name is LiBackpack. And you can add it with a suffix.

- **Password**：The default password is greenvalley.

  Note: the password will be reset to the default after system update.
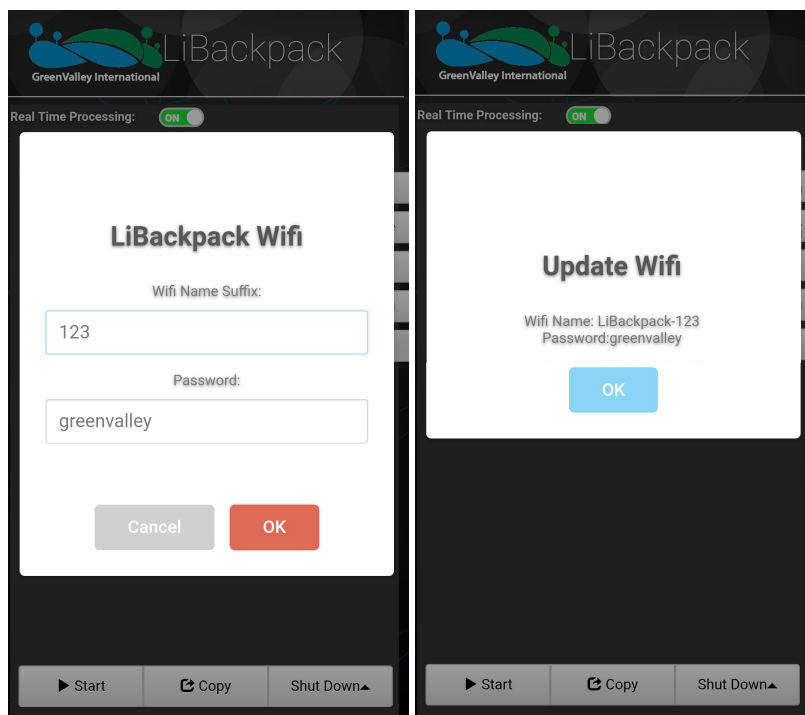
WIFI Settings

5.9 Collect Point

If you need to verify the relative accuracy of the device or register the cloud with geographical coordinates, you can collect points in handheld scanning mode. The installation method is slightly different from the backpack scanning mode, but the data collection method is completely the same.

5.9.1 Device assembly for point collection

To assemble the unit for collecting points: Install one of the top fixtures on the top of the scanning sensor, install the other top fixture on the bottom fixture, and then insert the scanning sensor into the bottom fixture, and finally connect the scanning sensor and the backpack mainbody by a connection cable. The operation is shown in the figure below:

- Install one of the top fixtures on the top of the scanning sensor, install the other top fixture on the bottom fixture.

Mount the fixture

- Align the red dots to insert the handheld extension cable into the laser scanner, and then insert the laser scanner into the bottom fixture. Screw tightly to fix the connection. Then, align the red dots to insert the handheld extension cable into the backpack mainbody.

connection

- Finished, see full device below:

Handheld mode

5.9.2 Collect Control Point

To collect the control points during data collection, click the **Count** button in the bottom page, set the counting time as 5s. If you need to use the top fixture to collect point, point the sharp end of it to a specific corner point, and set Height as 1mm; If you need to use the bottom fixture to collect point, point the sharp end of it to a specific corner point, and set Height as 0mm. See picture below.
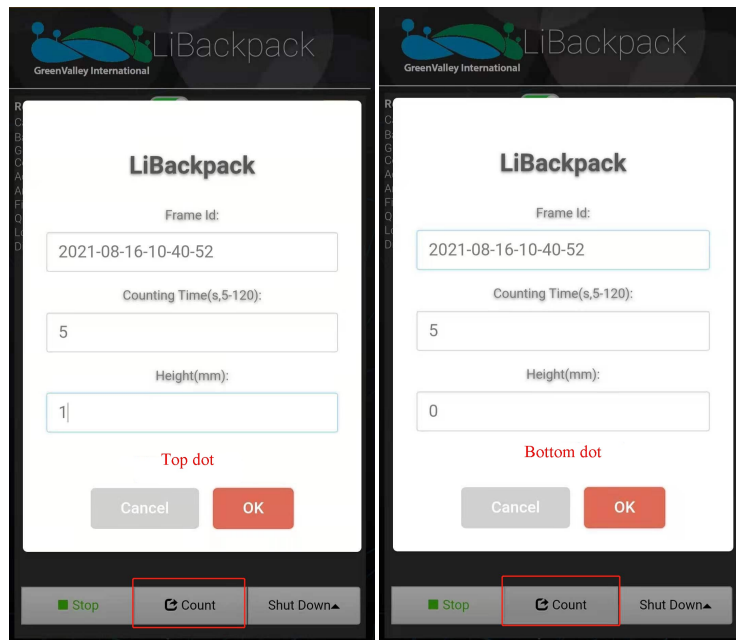
Collect control point

5.9.3 Check Control Point

You can check the control point collection after you process the point cloud data, see operation below:

- Select "Registration > Point Pairs" after data processing is done. Import **geotag.txt** under the working directory.
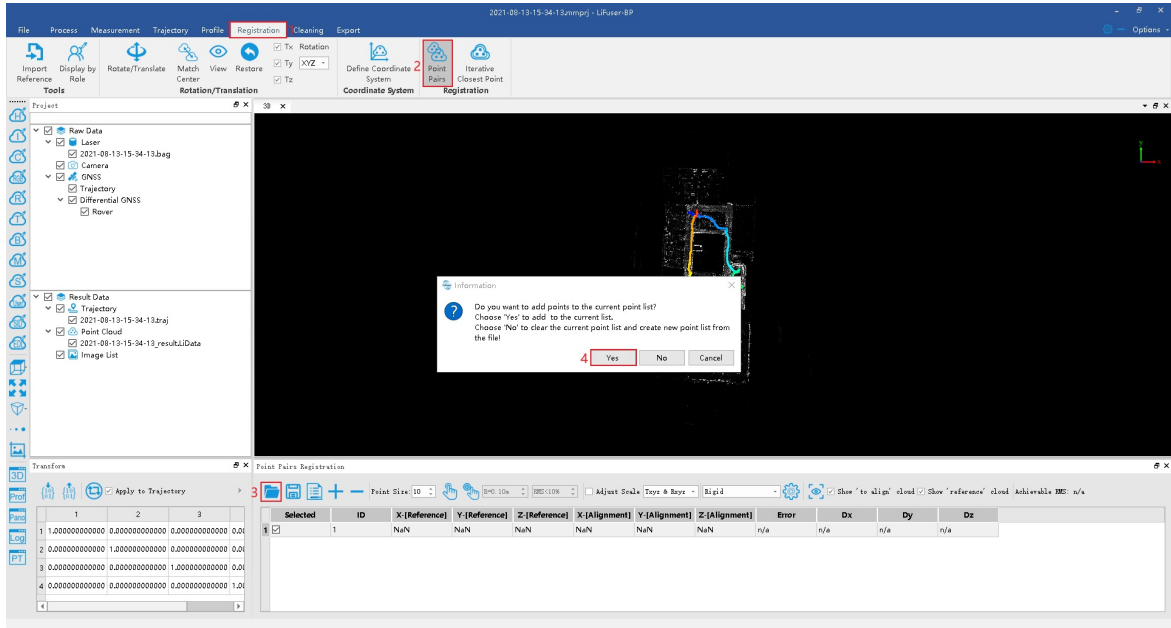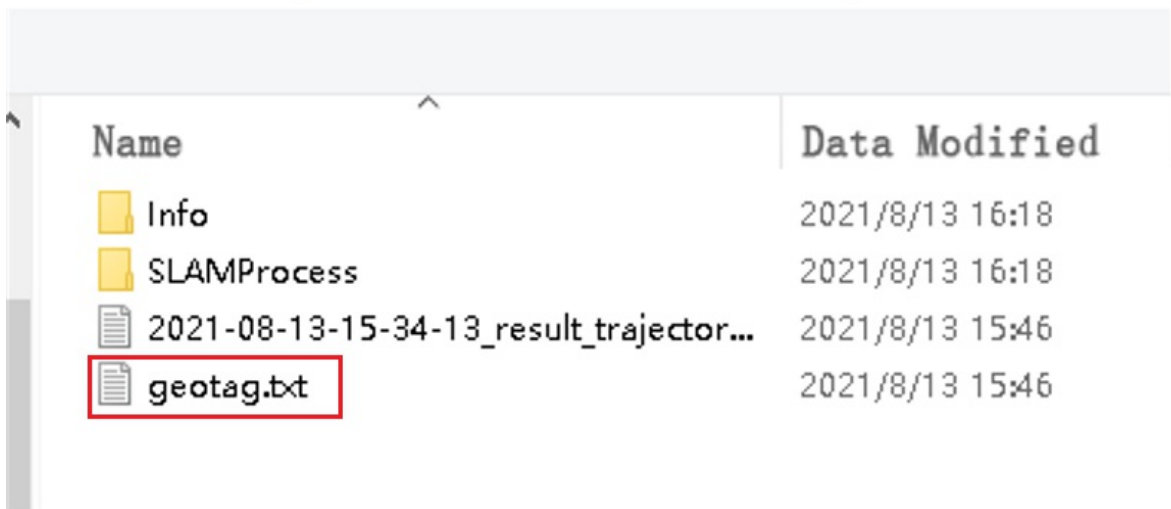
Import control point

- Skip the header, and set the control point file as "to align". Click **Apply** and you can check the control point in the point cloud viewer.If you need to do registration, just input the reference point clouds coordinates in the match table and click **Apply Transform".

Open ASCII Files

File Name:C:/Users/MLS/Desktop/1/4/2021-08-13-15-34-13/geotag.txt

1	2	3	4	5	6	7
Name	X-Alignment	Y-Alignment	Z-Alignment	X-Reference	Y-Reference	Z-Reference
2021-08-13-15-34-45	2.74675971672684	-1.13058127832972	0.0451093399524689	0	0	0
2021-08-13-15-35-23	10.5174512286112	-5.66329757104872	0.850592469930649	0	0	0
2021-08-13-15-36-08	14.2535448151529	-17.1407748732604	1.72470044285059	0	0	0
2021-08-13-15-36-44	14.9381706918925	-21.0143757927269	1.75096703779697	0	0	0
2021-08-13-15-37-36	2.16371936677396	-38.6118290057331	0.0867320279479027	0	0	0
2021-08-13-15-38-30	0.709165784269571	-17.342139936462	0.956775786861777	0	0	0
2021-08-13-15-39-14	2.1889235483855	-1.12312355143204	-0.0336528825163841	0	0	0

Skip lines

1

Separator

Default: ☑ ESP ☑ TAB ☑ , ☑ ;

Custom: [ ] (ASCII code:)

Apply   Cancel

Point cloud registration

6. Standard Operation Procedure

For better results, the environment to be scanned by LiBackpack should include a variety of three-dimensional structures. Set screen auto-lock mode on the mobile device to 'Never', or the WIFI connection between LiBackpack and mobile device may be interrupted if the screen is locked. If the screen is locked, unlock it and reload the page to refresh the real-time data collection. When using the scanner, please follow the instructions below:

6.1 Data Acquisition

1.Follow the Workflow (5_WorkFlow.md) to set up the system. Starting at a stationary position, make sure that laser scanner is at horizontal level. Start scanning route after point cloud appears on the screen (about 5 seconds).

2.For outdoor data collection, start scanning in a relatively open field. For indoor data collection, start scanning at the center of the interior space. Do NOT start scanning in a corner or close to walls.

3.Do NOT operate when battery level is below 30% to prevent battery over-discharge.

4.When connecting in WIFI mode, do NOT connect more than one mobile device, it may cause transmission latency and other control problems.

5.In WIFI mode, keep the mobile device within 5 meters of the LiBackpack C50 to avoid transmission latency and connection errors.

6.It's recommended to keep each collection session within 30 minutes and less than 2km. After collection, turn the power off for 5 minutes, allowing the laser scanner to cool down. Shorter collecting session is advisable if the temperature is above 30°C and please check the data collected in a timely manner.

7.Before Data Acquisition: Make plans for the acquisition routes. Click on Start button and walk in the "8" pattern (about 1 minute) to ensure the convergence of IMU precision.

8.During Data Acquisition:

(1) Please check camera status from time to time. Do not panic if there is a disconnect, which is due to interrupted Wifi signal. It is highly recommended to promptly check the data files.

(2) If the acquisition process undergoes electromagnetic interference, Wifi signal is susceptible to interruption. Please do not turn off the scanner in this area. Turn the scanner off in an area with stable WiFi and little interference.

9.After Data Acquisition:

> (1) To ensure the data quality, you need to continue to walk in an "8" pattern after acquisition, which takes about 1 minute. (2) Each time after acquisition, please use your laptop to see if data quality is satisfying. Please re-collect if it is not.

6.2 Route Planning

1. Closed loops will improve data quality.
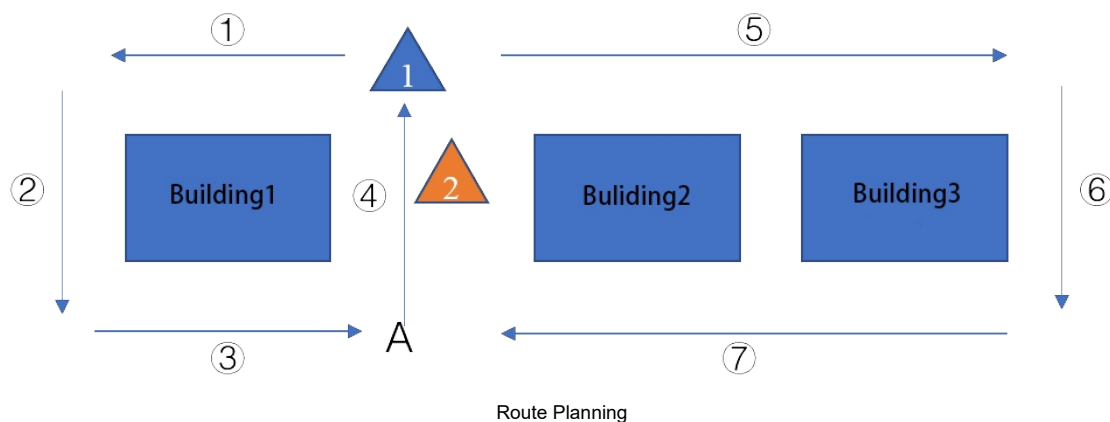
Route Planning

As shown above, building 1, 2, 3 are the scanning targets. Recommended route is ①②③④⑤⑥⑦ or ⑤⑥⑦④①②③. Always plan the route carefully before mission and follow the route when scanning.

2.Closed loop will help to reduce drift error. For example, if the scanning route is ①②③④⑤⑥⑦, then make sure you pass and go beyond position A in the end to overlap segment ③ or ④ for at least 5 meters.

3.Slow down (ideally 1/5 of usual speed) when going around corners or moving from one room to another. Scanning on stairs.

4.It is strongly recommended to NOT rotate the laser scanner. If have to, turn around your body instead of scanner itself very slowly (rotation speed < 30°/S). The environment must have rich features. Do NOT attempt to rotate the scanner at the center of an empty room.

5.Before performing indoor scanning, open the doors along the route before start scanning. Do not move the doors during scanning.

6.Avoid winding routes or back and forth, as this can cause thick point clouds of the walls.
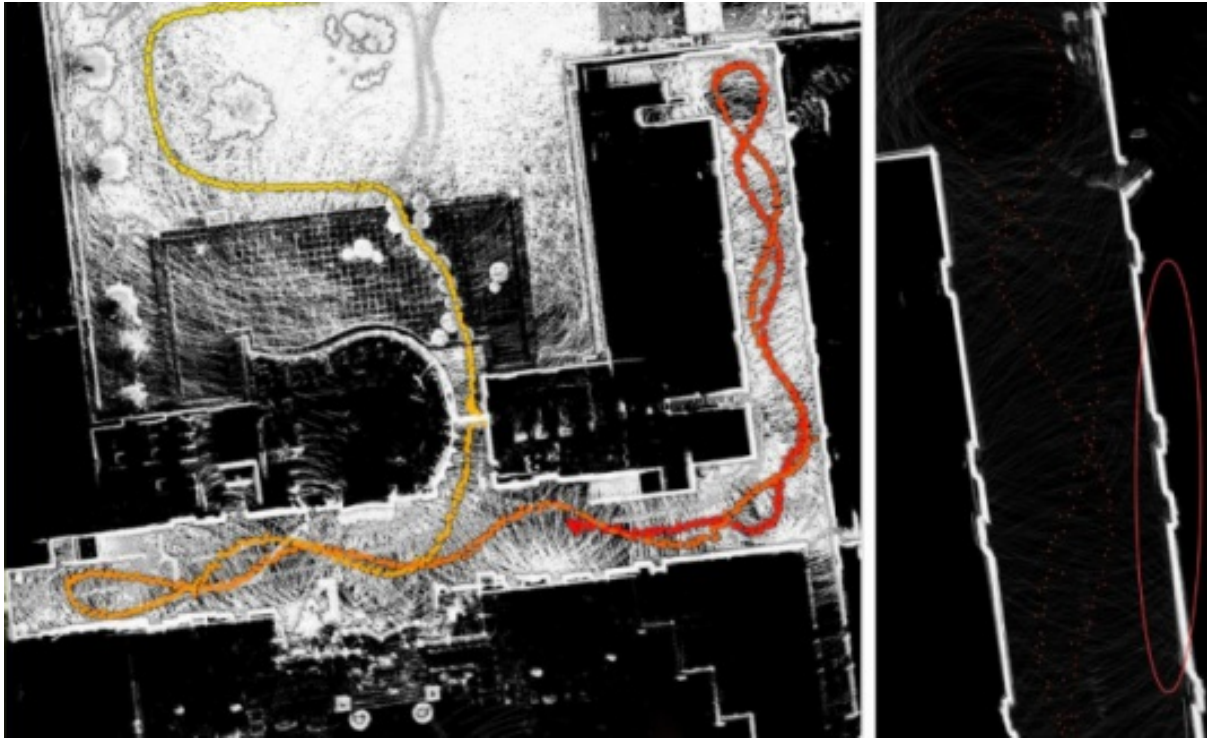
Winding Routes

7.Avoid scanning the same area for multiple times
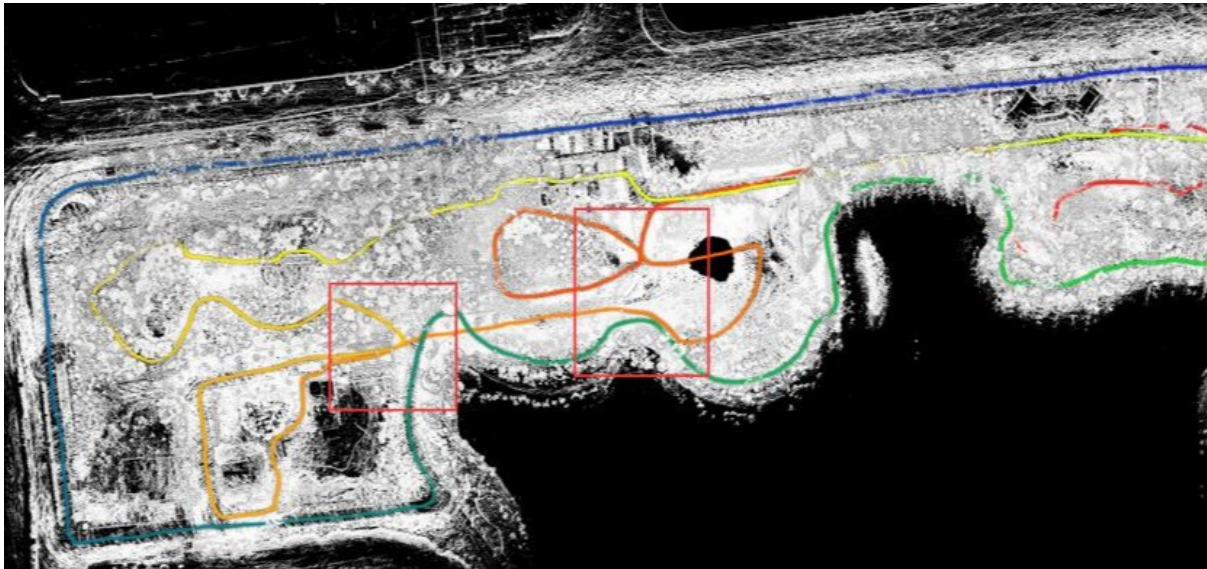
The Same Area Scanned Multiple Times

8.For a large target site, break the site into small sections. Move from one section to another and close the loop for each section.

9.Walk on the same side of a road to close the loop in a round trip. Walking on the two sides of a road back and forth could result in mismatch of point clouds. As the two sides are in short distance, however, with only small part of point clouds overlapping, even a closed loop cannot help solve the accumulating problem. To scan both side of the road, create two separate projects, and merge the point cloud in post processing.
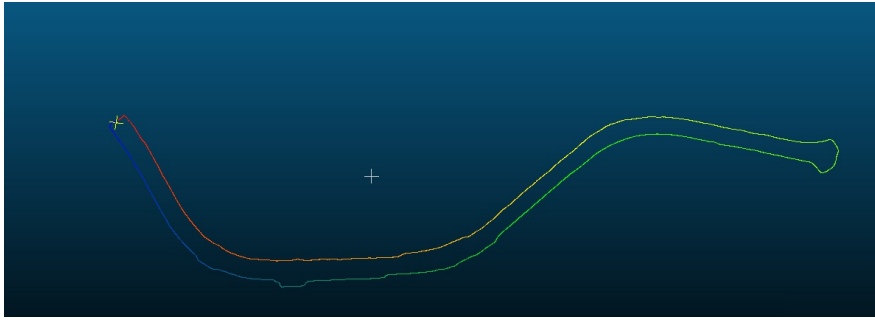
Round Trips on the Same Route

Example Route planning for a 30*30m forest site.

Plan for routes so that all useful information is captured by the acquisition with minimal redundancy. For a plot of 30m by 30m, use the route plan on the left for dense vegetation, or the one on the right for sparse vegetation.
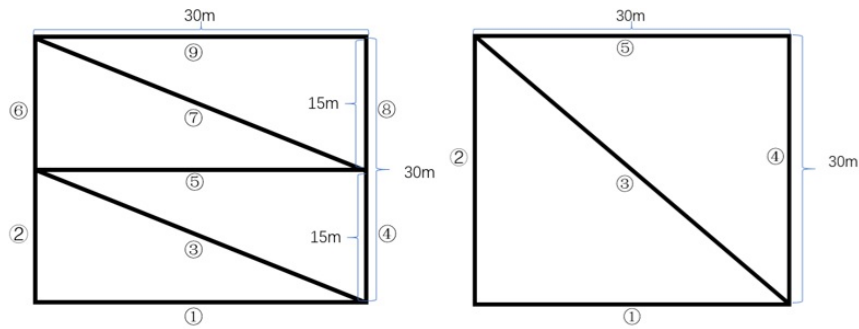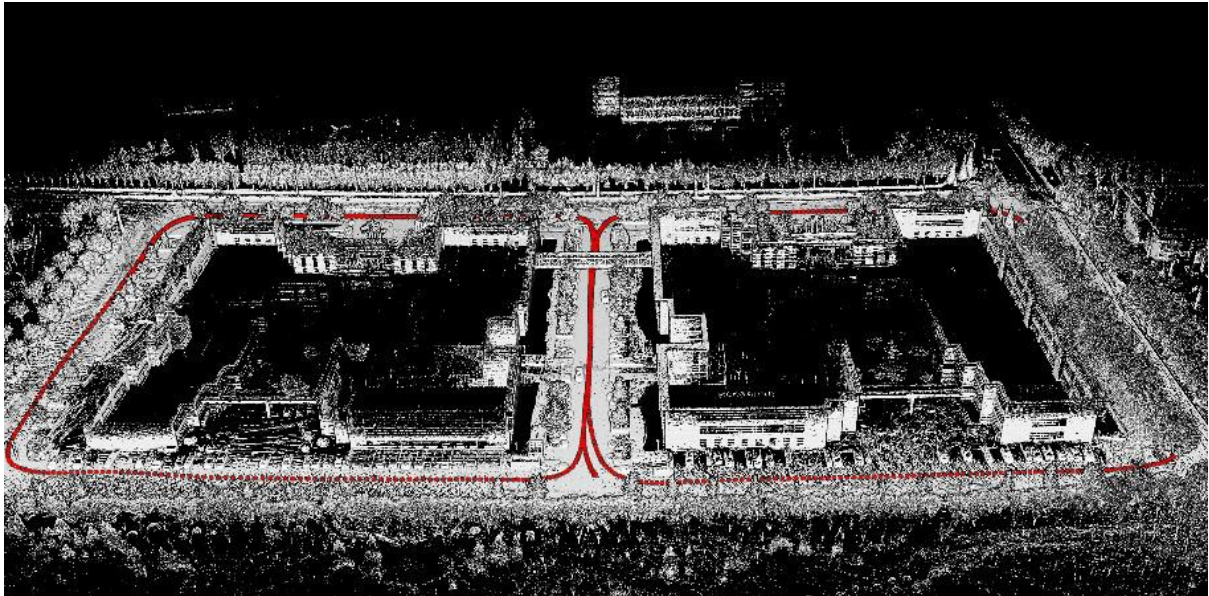

Route Planning（Dense forest：Left Sparse Forest：Right）

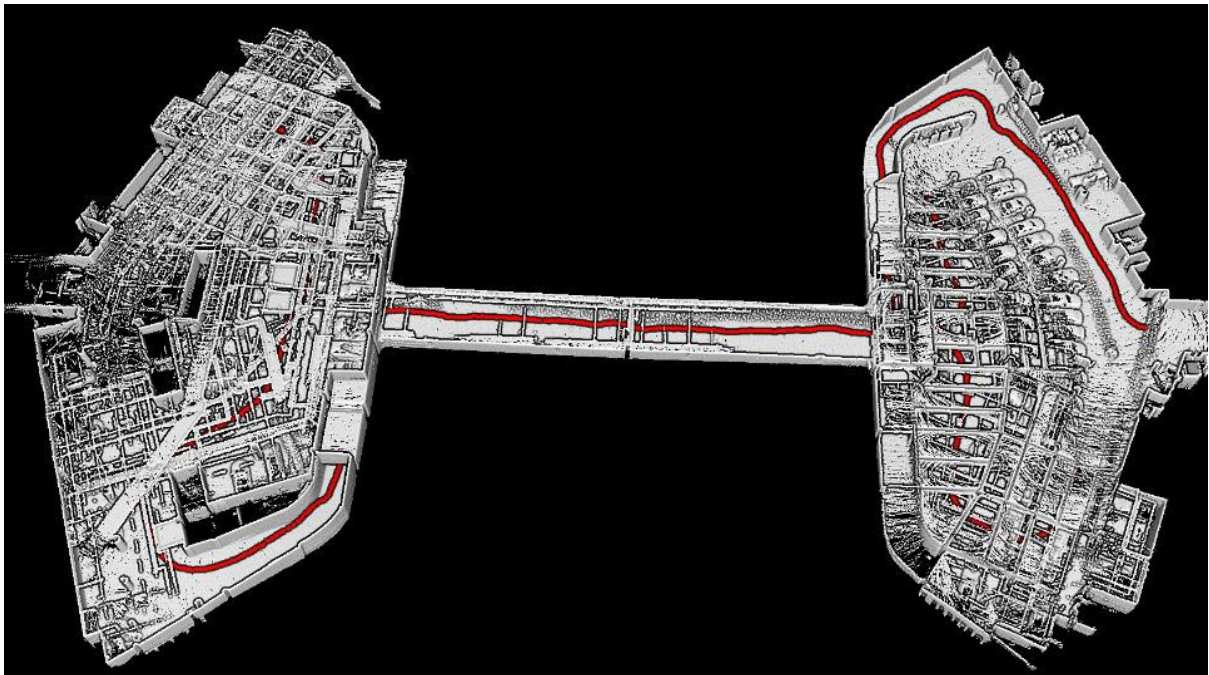## 6.3 Suitable Environments for LiBackpack

Environment with rich 3D structures will produce good scanning results e.g. furnished offices, forests, residential neighborhoods, etc.
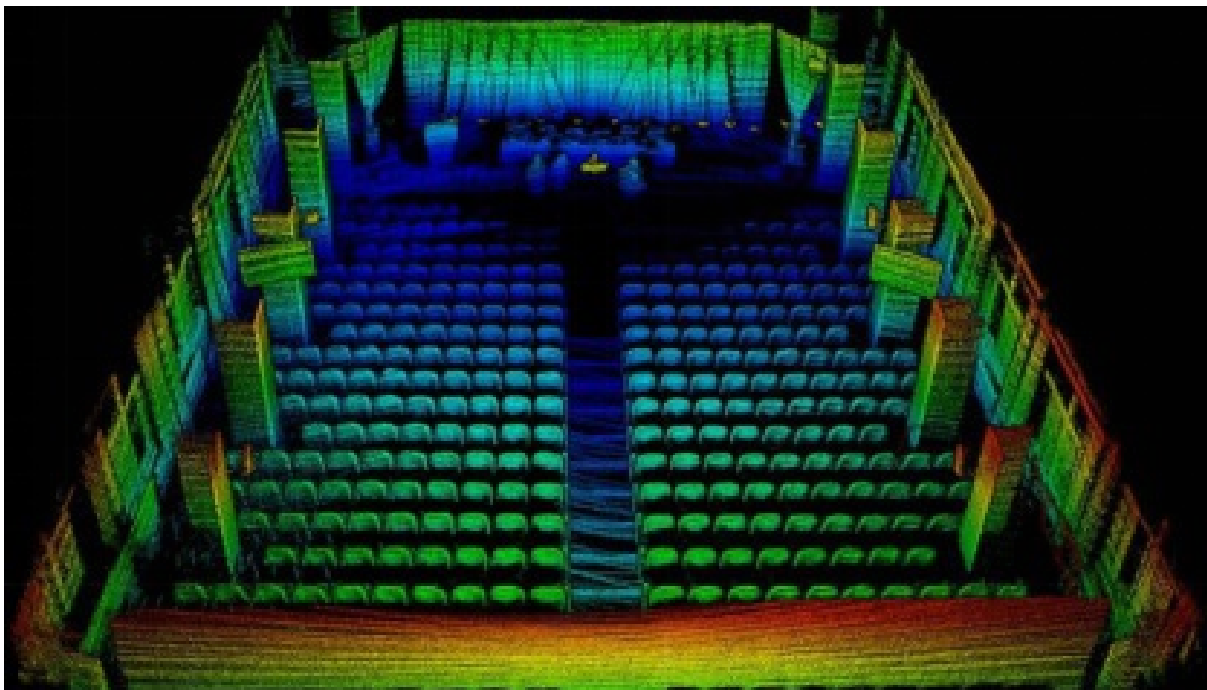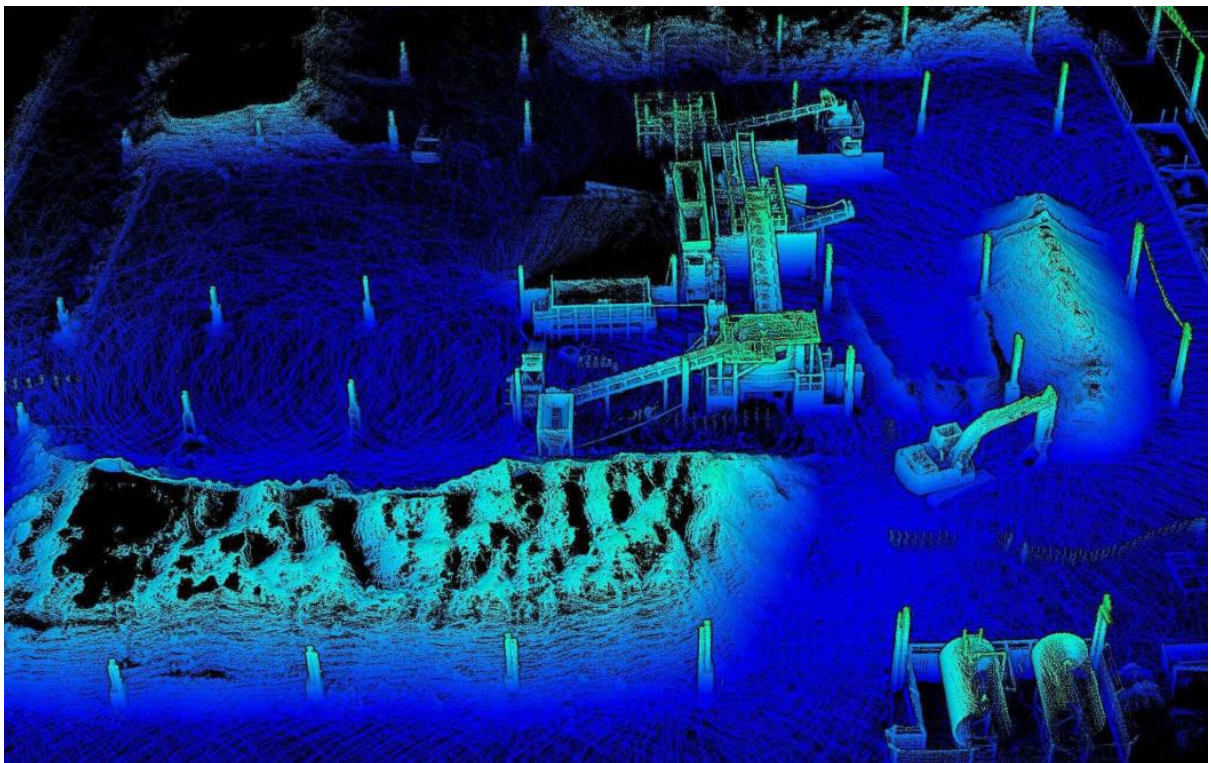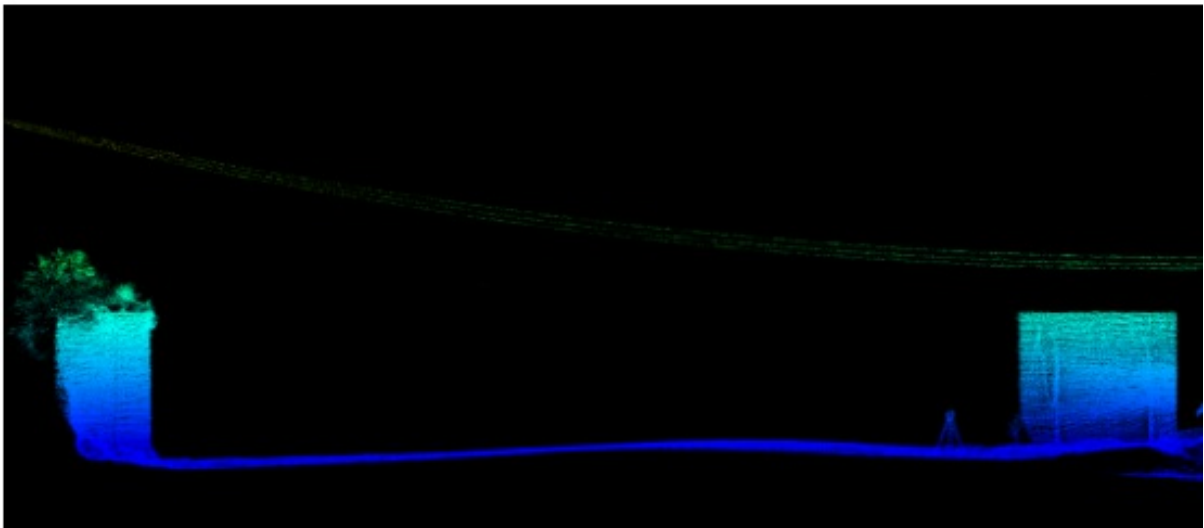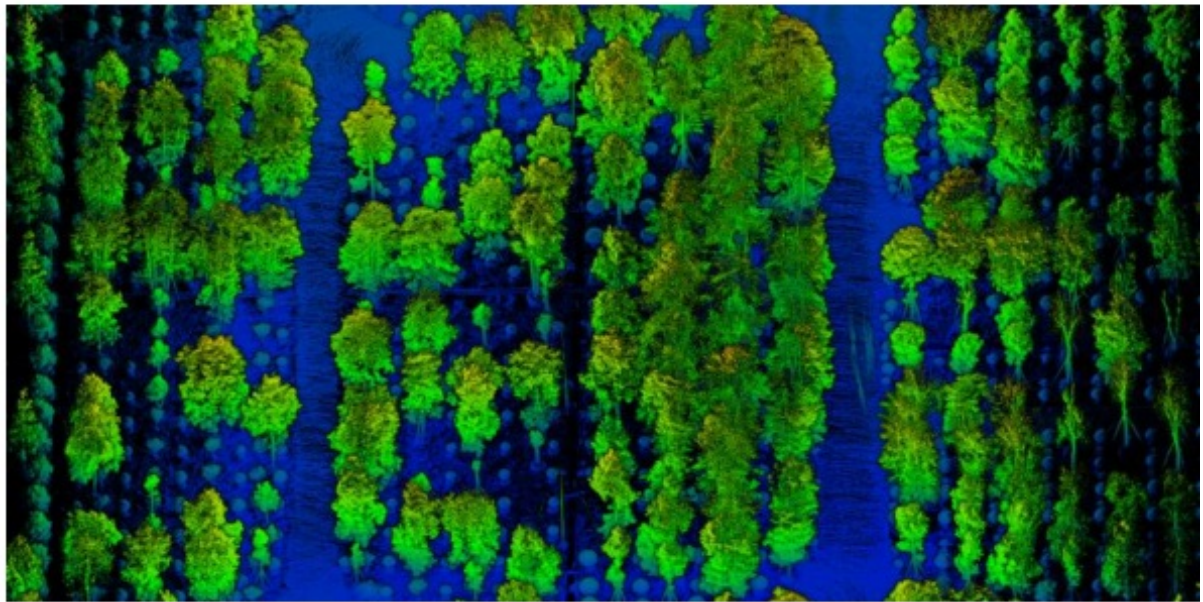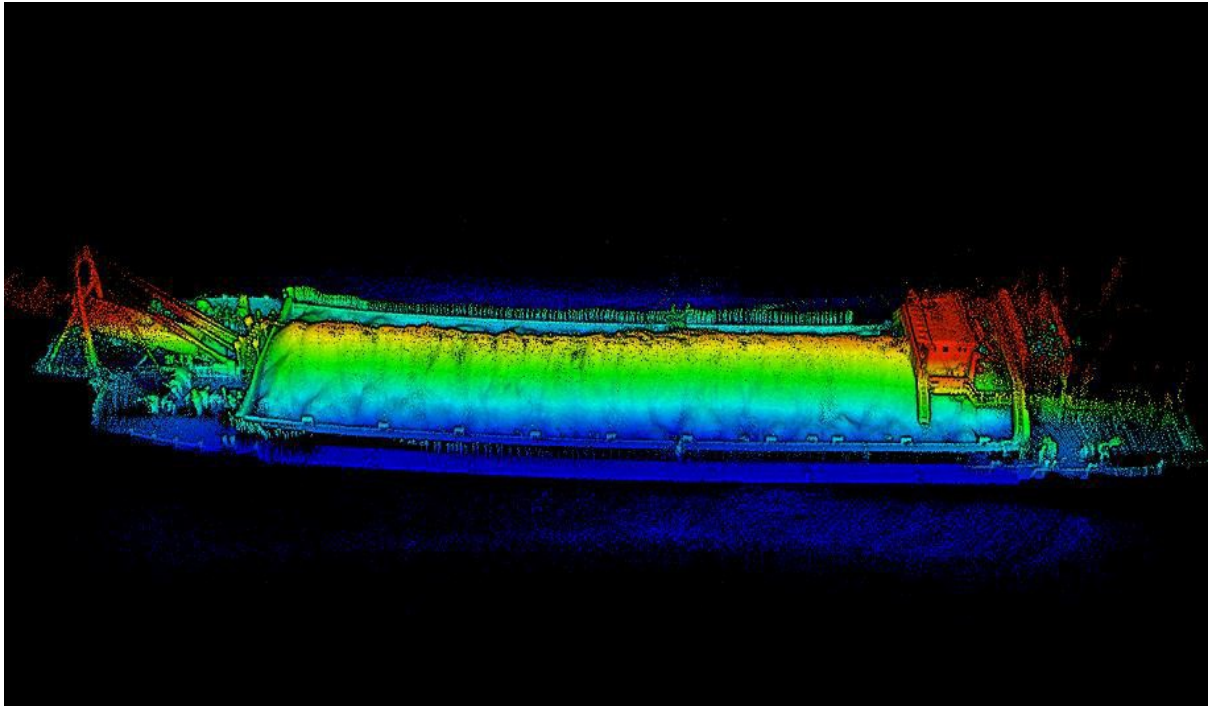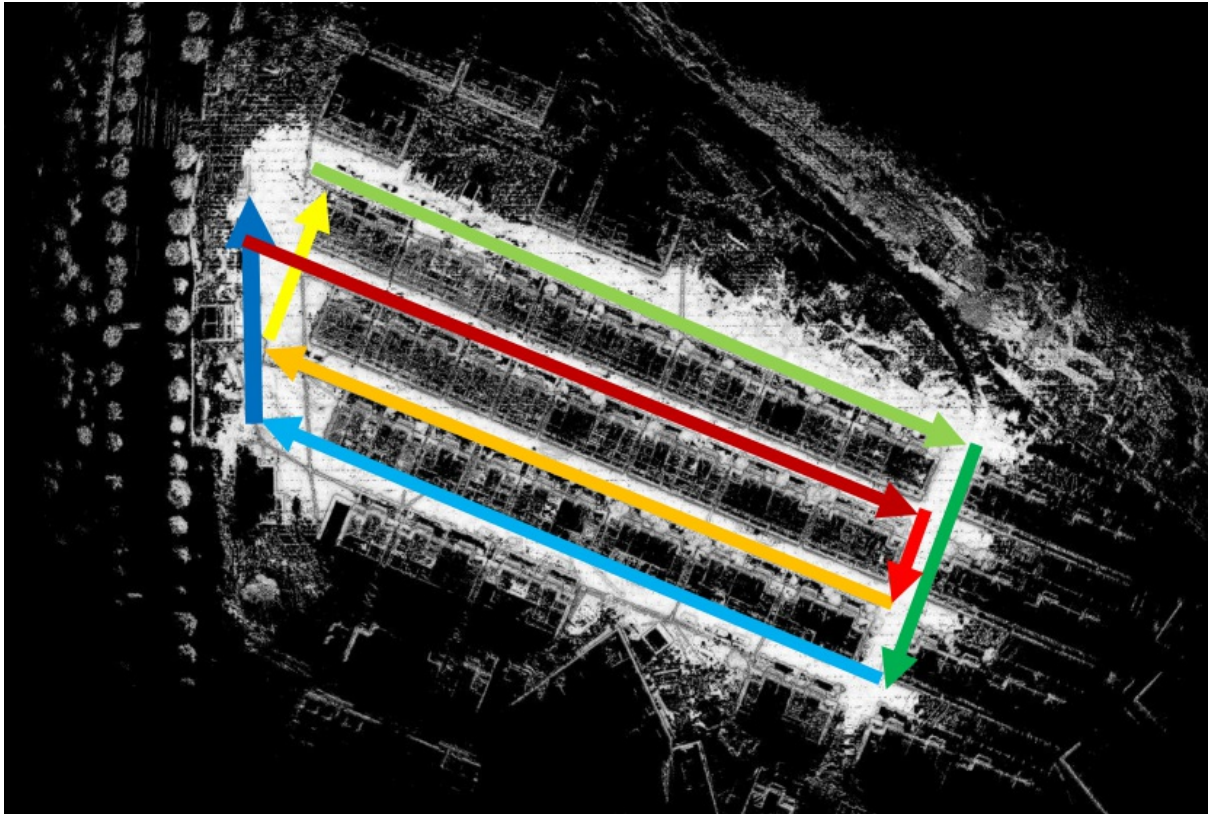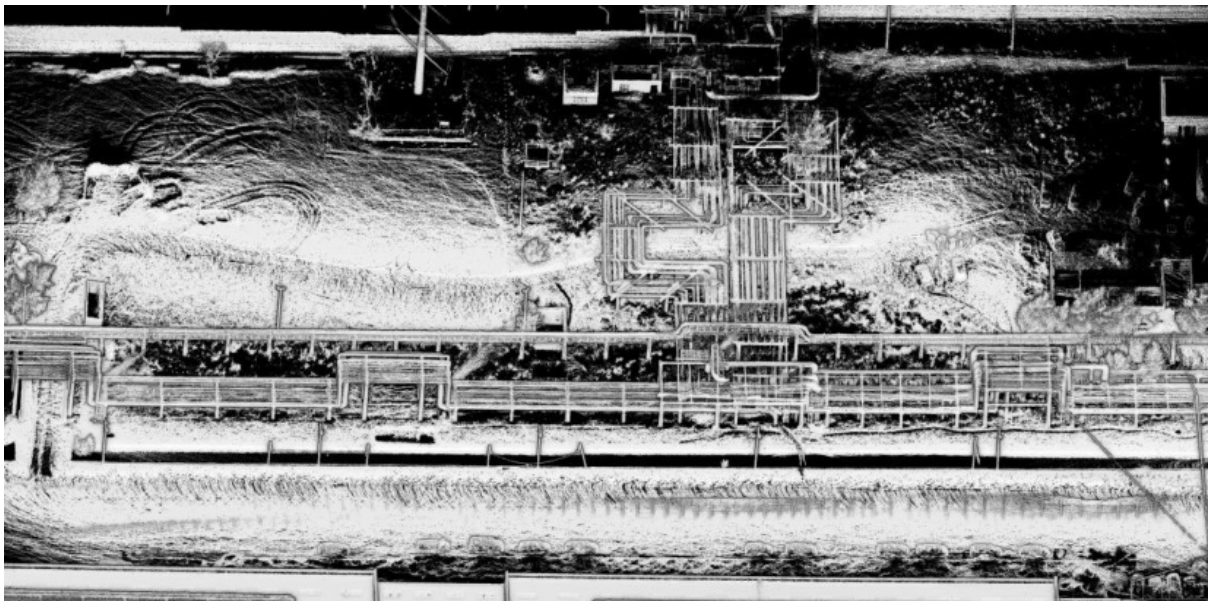

Auditorium

Office Building

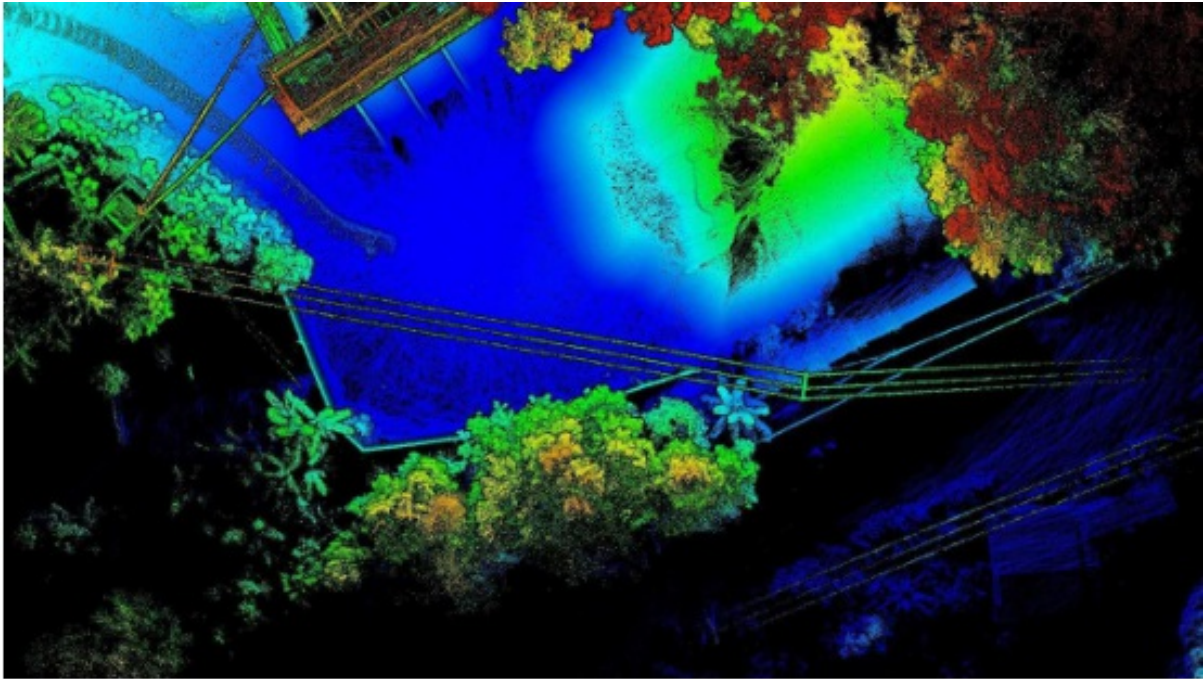
Underground Garage

Forest Land

Sand Barge

Construction Site

Building Foundation

Pipelines

Power Line Corridor
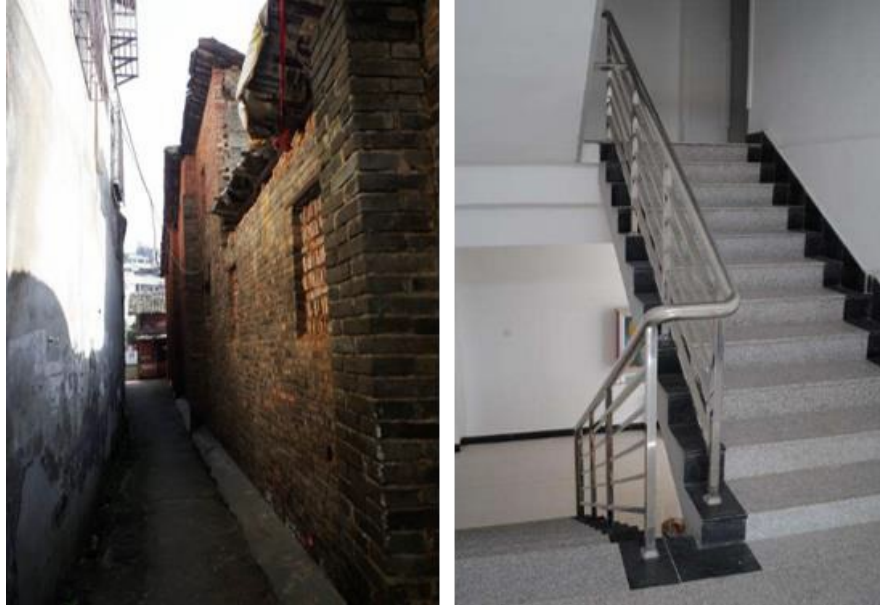
6.4 Less suitable environments for LiBackpack

Environments with insufficient features are not suitable for LiBackpack scanning, including but not limited to:

- Grassland, snowfield, barren lands, etc.

Environments with Insufficient Features

- Narrow roads, stairwells, and other tight spaces.

Tight Spaces

- Surfaces with very strong reflectance such as painted glasses.
- Surfaces with strong geomagnetic interference.

6.5 Other Guidelines

1. Avoid scanning when there are too many moving objects.
2. When scanning large areas, raise the scanner above the operator's head to give the scanner a 360-degree view.
3. To merge data from multiple scans, use specialized Target Spheres as control points. Place Target Spheres above ground, preferably on tripods, to ensure the spheres are fully scanned. A minimum of 4 Target Spheres are required to merge the two separate scans successfully. Don't place Target Spheres in a straight line or at the same height.
4. For airborne data acquisition, the flight altitude may not exceed 15 meters.
5. For automobile acquisition, movement speed should not exceed 20km/h (12.5mph) with a slow turning speed under 30°/S.
6. Keep the scanner as steady as possible to ensure best quality.
7. When downloading data, do NOT remove the flash drive until the 'Completed' message pops up.
8. Do not use the provided Surface tablet for other uses.
9. Avoid direct sunlight, which may cause extra noises.
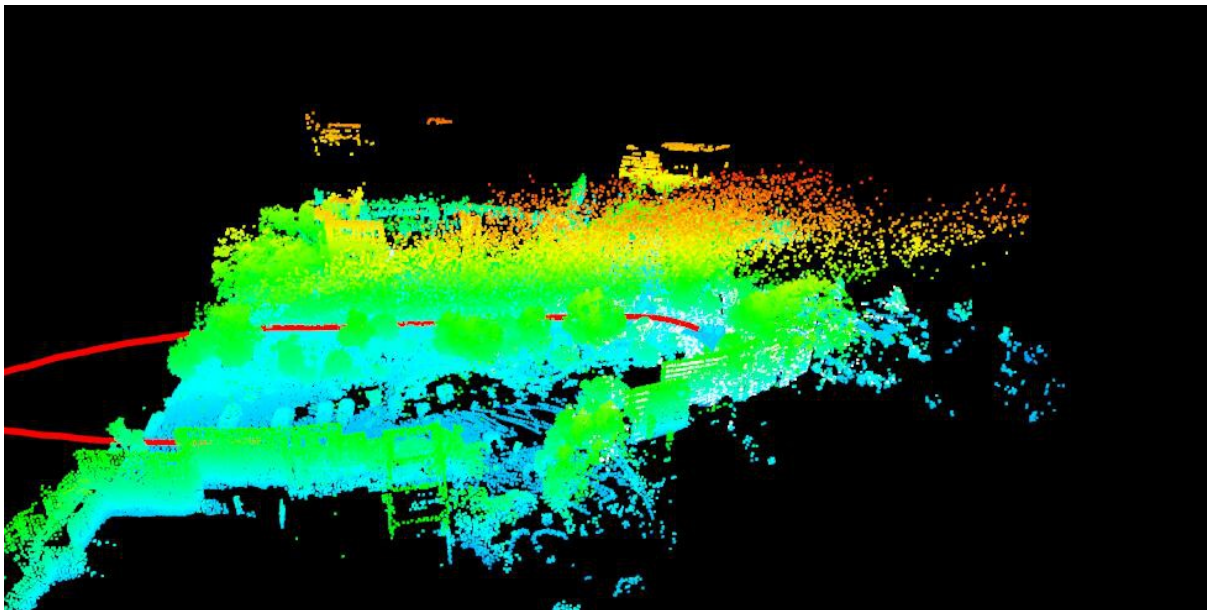
Noise caused by direct sunlight hit.

7.FAQ

What should I do if I cannot find the LiBackpack Wi-Fi connection after powering on the system?

In general, in 1 minute after powering on the LiBackpack system, a Wi-Fi connection called 'LiBackpack' should be available. If not, try refreshing your phone or tablet. If the problem is not resolved after 5 minutes, please power off the system, reboot the computer, and then search for the Wi-Fi connection again. If the problem still exists, please contact our support team (info@greenvalleyintl.com) to diagnose the issue.

What should I do if no point cloud is displayed after clicking Start on the system control UI?

It is most likely caused by the fact that either the Ethernet cable is not plugged in completely or the port is not functioning correctly.

Please ensure that:

1. The laser scanner is powered on;
2. The cable is plugged in completely if the wired Ethernet connection mode is being used;
3. The light on the Ethernet port is flashing;
4. Clear the browser's cache on the mobile device if it has been connected to other devices.

What should I do if clicking "start" button, only the point cloud data displays on the UI and the status information doesn't appear on the upper left of the screen?

Please reboot the system. If the problem remains, please contact GVI by email (info@greenvalleyintl.com).

Is there a limit on the time duration for data collection?

The recommended time duration for a single collection project is 30 minutes. While working, LiBackpack C50 produces raw data at a rate of roughly 10M/s. Longer data collection time may result in large data file size, which might slow down the system's data copying and processing speeds.

Why is there lag on point cloud display on the UI?

Please Check:

- If there is more than one UI device connected to the LiBackpack Wi-Fi. Multiple connections will slow down the data transfer process.

- If the connected UI device is located far away from the LiBackpack system. If so, please ensure that the device is moved closer to the system.

- The Queue Size on the upper left of the display. If the queue is larger than 50, that means that the data is being processed and there will be lags on point cloud display.

Why do the laser scanner and computer not start after powering on the LiBackpack system?

Please check:

- (1) if the battery percentage is low
- (2) if the battery is correctly connected.
- Please avoid over-discharge which can cause damage to the battery.
- It is recommended that the battery is charged or changed when the battery percentage is lower than 30% and that the power cable is disconnected when the scanner is off.

What should I do when LiBackpack Wi-Fi is found but the UI device cannot connect to it?

It is recommended that the Microsoft Surface Pro tablet included with the LiBackpack system at the time of purchase is used for data collection.

- Please follow the instructions below, if you are using an Apple or Android product as the UI device:
- If the device is an iPad or iPhone, please refer to Apple's instructions for resetting the network settings, or follow these steps (Settings->General->Reset->Reset Network Settings):
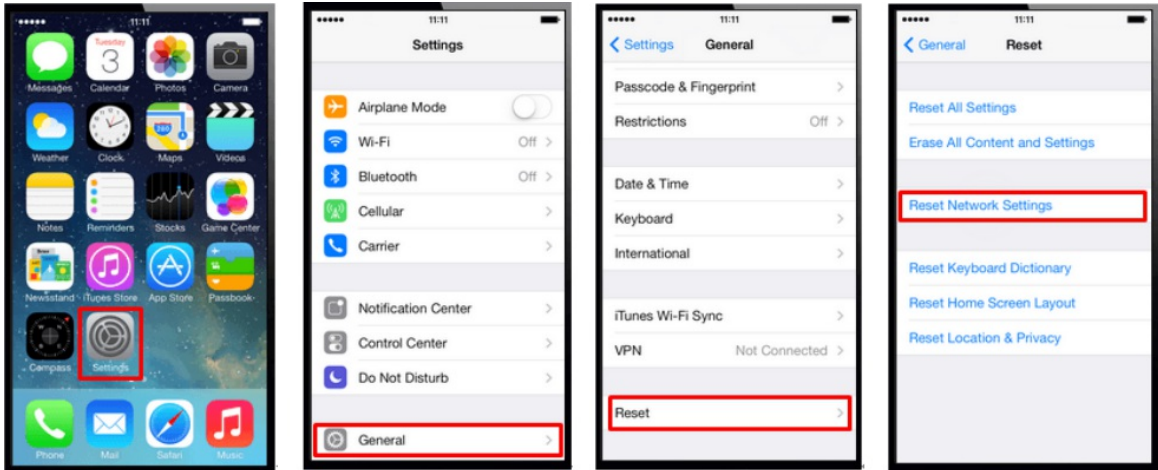
- If the device used is an Android device, please follow these steps to reset and reconnect to the LiBackpack Wi-Fi (Settings->System->Reset->Network settings reset; steps may vary with make and model):
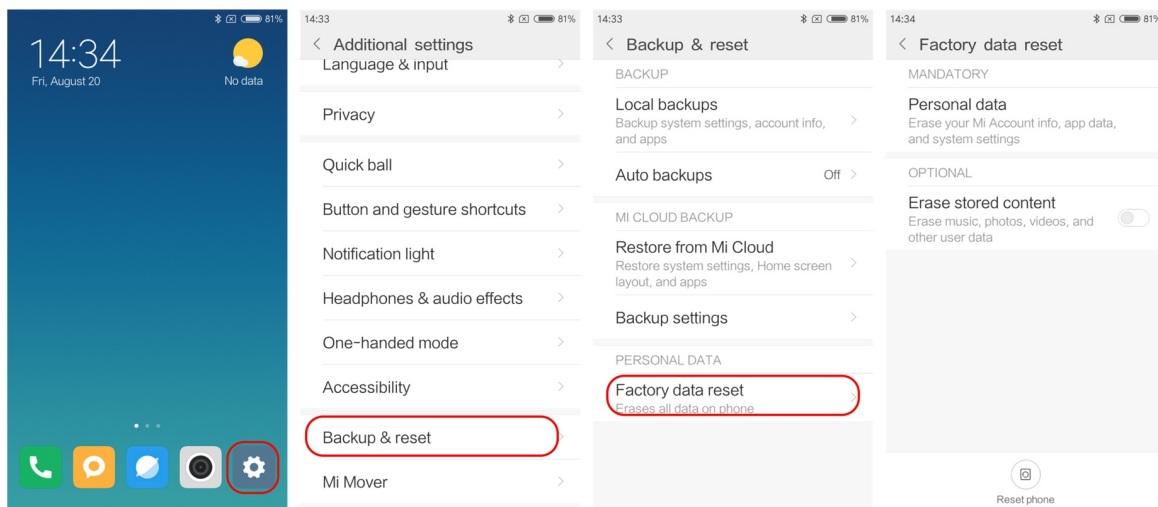
What should I do when 'Unable to connect' popup appears during data collection?

The appearance of this popup is most likely to be caused by Wi-Fi interference. This does not affect the data collection process. Check the Wi-Fi connection. Reboot the Wi-Fi on the UI device if the problem remains, and then reconnect to the LiBackpack Wi-Fi.

What should I do when I cannot open the copied data?

Please ensure that:

1. The USB flash drive is formatted to a single NTFS sector;
2. The drive was not unplugged until the process bar reaches 100% and the notice to unplug the drive appears on the display.

To reformat the flash drive to NTFS or exFAT format, please follow these steps:

1. Plug in the USB disk.
2. Open "This PC"
3. Right-click the disk, and select Format…
4. Select the "File system" as NTFS or exFAT and click "Start".

## What should I do when the copy process bar remains at 99% for a long time?

This is likely to occur when large quantities of data are being copied. You should wait for the message that file transfer is completed before removing the USB drive or shutting down the system to avoid data loss and/or damage to the drive.

Does LiBackpack come with a point cloud post-processing tool?

We recommend using LiDAR360, a comprehensive point cloud post-processing suite developed by GreenValley International. LiDAR360 provides comprehensive toolsets for point cloud visualization, processing, analysis, and other tasks.

Is the output point cloud calibrated to be vertical to the ground?

Yes, LiBackpack point cloud processing will adjust the tilt angle of the scanner based on analysis of the IMU data. The tilt angle accuracy is in a 1–3° range.
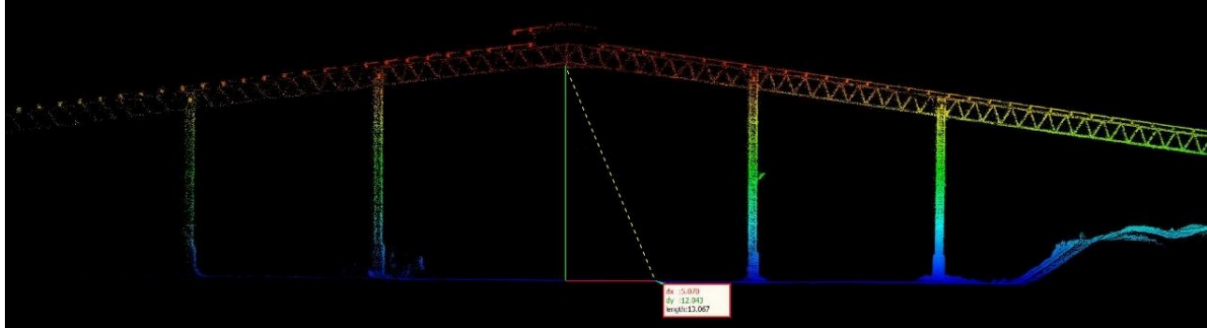

Why are there large amounts of high-level noise points observed in the point cloud?

These noise points are highly likely to be caused by direct sunshine. You can consider performing the scanning when there is no direct sunshine, or you can use the "Remove Outliers" tool in LiDAR360 to remove these noise points.

Why can repeated scanning of the same area or closed-loop scanning cause mismatch of the point cloud?

Closed-loop scanning refers to walk through the route with closed loops while collecting data with LiBackpack C50. Currently, LiBackpack C50 performs real-time processing and closed-loop optimization. However, because of environmental factors, the closed loops may not be detected automatically in certain scenarios. Optionally, please send raw data file along with a data introduction to GVI for further analysis and processing.
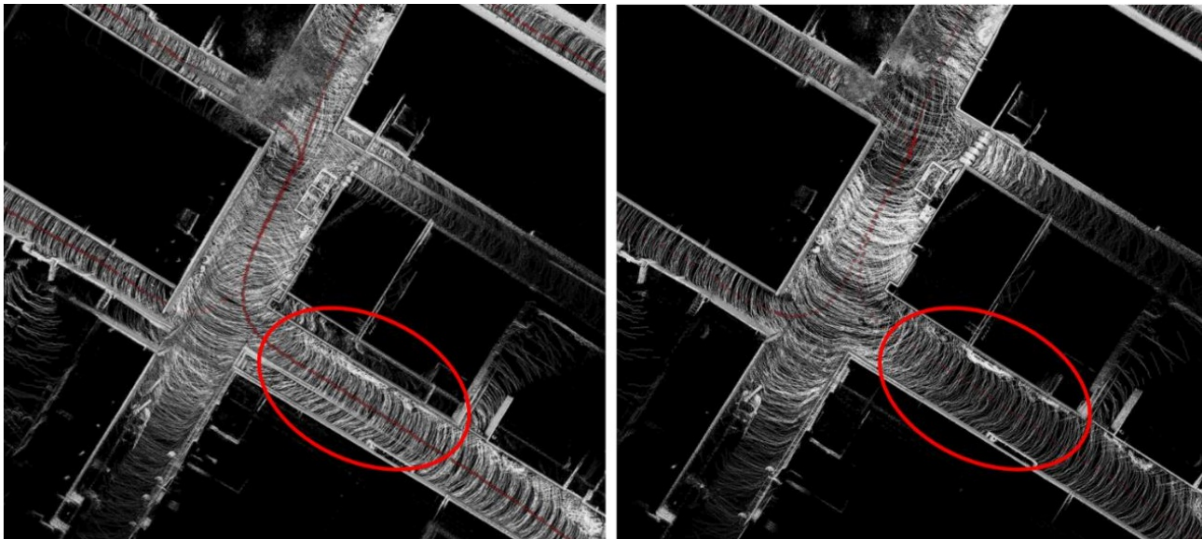

In what situations will the accuracy of the output point cloud be reduced?

- In cylindrical/spherical tunnels or buildings without rich 3D structures. When using the device in cylindrical tunnels or buildings, it is hard for the device to find enough 3D features, which might affect the key points matching process, and therefore influence the accuracy of the mapping accuracy.
- In areas with reflective surfaces, such as glass. Highly-reflective surfaces may result in matching errors and more noise points in the collected data.
- In narrow scanning environments such as small rooms, narrow hallways, and stairways, which may also cause matching errors. The limited vertical field-of-view (FOV) of single VLP-16 results in a lack of data for the top and bottom of the scanned environment, which thus affects matching accuracy.

Can I align multiple point cloud datasets or georeference them?

It is recommended that specialized referencing targets are used as control points to align multiple point cloud datasets or to georeference a single point cloud during post processing. Referencing targets should be placed over datum monuments when the goal is to use them to georeference LiBackpack point clouds. LiDAR360 has a Manual Registration (Rectify) Tool which allows users to complete scan-to-scan alignments and/or georeferencing processes. When target spheres are not available, you can align multiple point clouds with LiDAR360's Manual Registration (Rectify) Tool by using pairs of co-located points found in overlapping regions of the to-be-aligned point clouds.
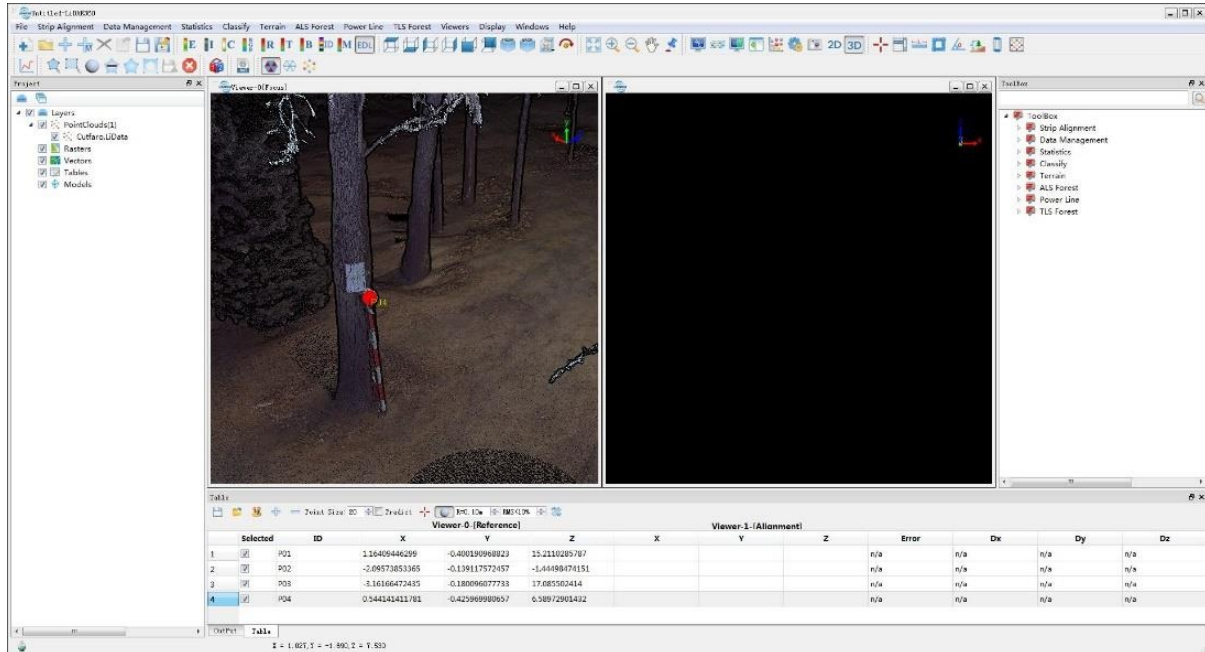
How long can I scan with LiBackpack on one battery charge?

LiBackpack can operate for 2 hours with one fully charged DJI TB47S Intelligent Flight battery.

What are the recommended operation environment and conditions?

Operation of the system should be carried out when ambient temperatures are within the −10° to 60°C range. The Velodyne sensor has a rating of IP67. You should avoid operating the LiBackpack outdoors on wet-weather conditions.

What is the ANSI Laser Safety Standard rating of LiBackpack's LiDAR sensor?

ANSI Laser Safety Standard rating of LiBackpack is Class-1 (eye-safe).

Is my data collected with LiBackpack secure?

All data collected with the LiBackpack system is securely stored local on the system drive and not uploaded to any network. The data can later be transferred out to USB devices or deleted from the UI. If you encounter any difficulties with real-time data processing, please contact us at info@lidar360.com and send us the data with its documentations. We will post-process your data to produce high accuracy point cloud.

How long does LiBackpack's on-board data processing take to complete?

Data processing is performed by LiBackpack firmware in nearly real-time. However, data processing may take longer to complete in situations where there the scanning environment is spatially complex (contains many geometrically unique features), or there are large numbers of survey loops to close. Data processing should not take longer than 3 to 5 minutes to complete after pressing the Stop button for a scanning session no longer than 30 minutes.

What should I do if the flash drive is not detected after powering on the system?

Power off the system. Unplug the USB drive from the system, and plug it in again after powering on the system.

When can I unplug the flash drive?

It is possible to hot swap the drive if data copying is not in progress. DO NOT unplug the drive if data copying is in progress. Wait until the process is completed and a notice to unplug the drive is displayed.

Why can I not copy a file larger than 4 GB to my USB drive from LiBackpack?

Please ensure that the USB flash drive is in the NTFS or exFAT format. The FAT32 format does not support files larger than 4 GB.

Why can't I open the .ply file I transferred from the LiBackpack's internal storage?

This indicates that the file is incomplete or corrupted, which is probably due to the disconnection of the flash drive before the data copying process is completed. Please copy the complete data again.

8. Appendix

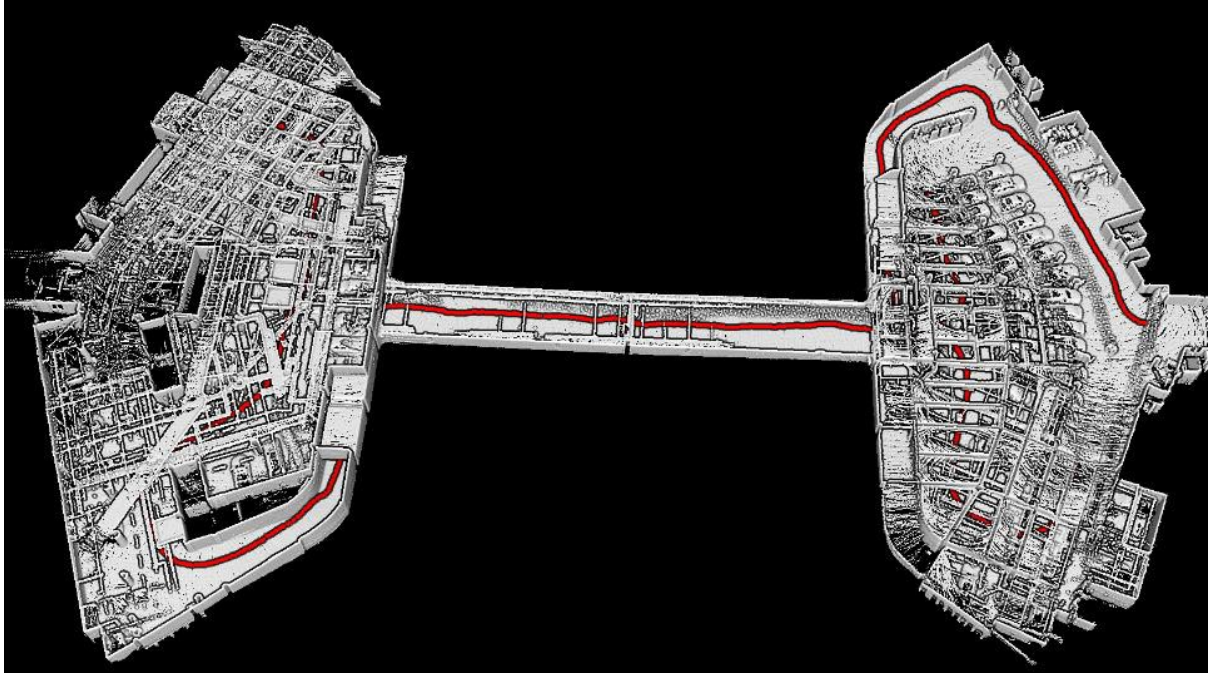## LiBackpack Sample Data:
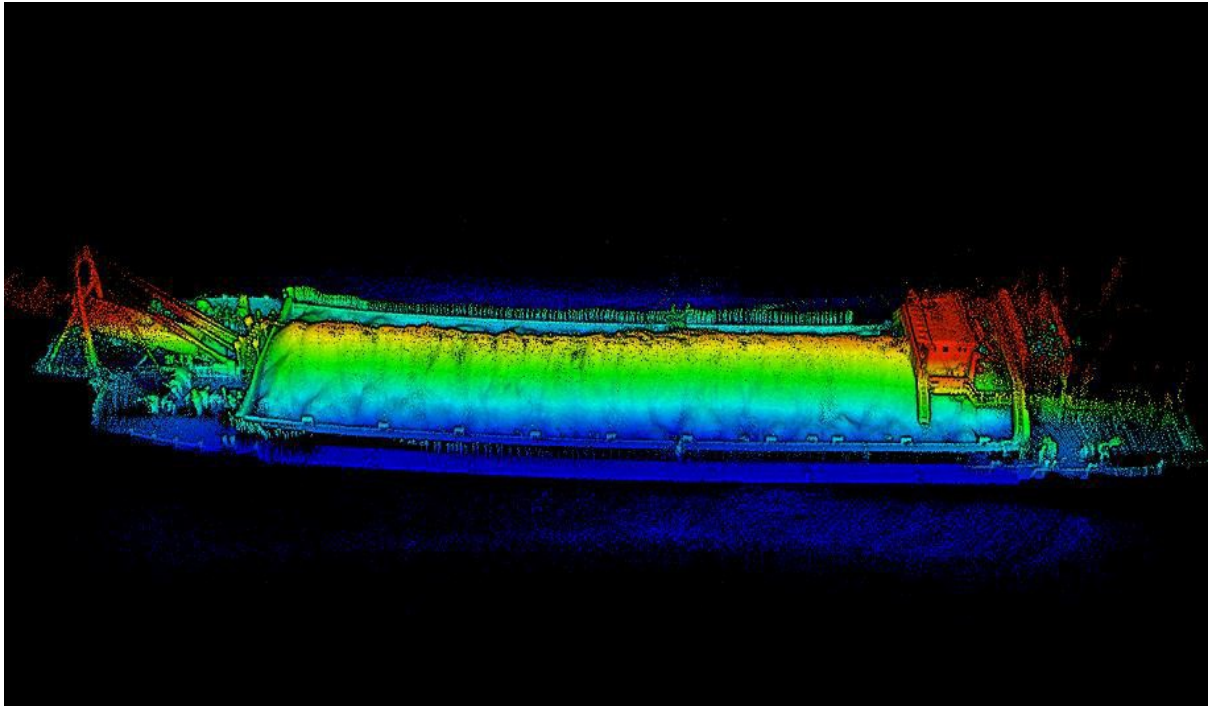
Indoor scenes (hotel, conference room, office, and auditorium), parking lot, underground parking garage, office buildings, forestland, sand barge, construction site, pipelines, and powerlines. All data are displayed in LiDAR360, GVI's all-in-one software that provides comprehensive LiDAR solutions. LiDAR360 supports regular point cloud display modes by height, intensity, classification, return, etc., along with EDL and GLASS special filters for the best data display effects.
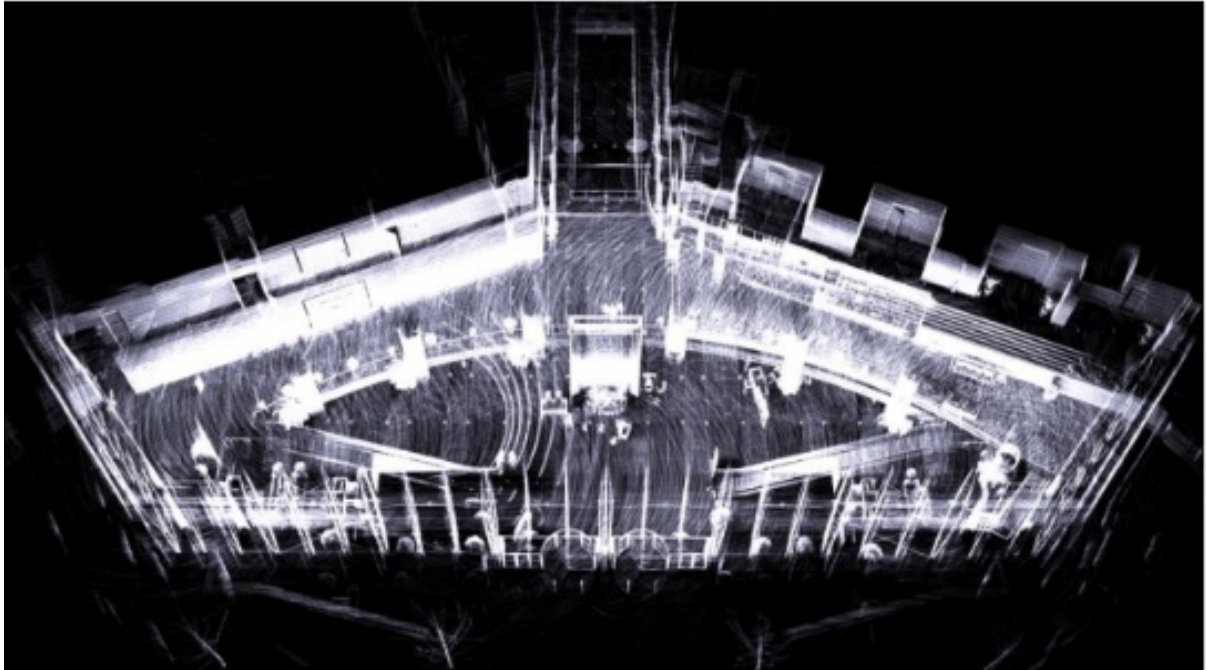
Point Cloud Data
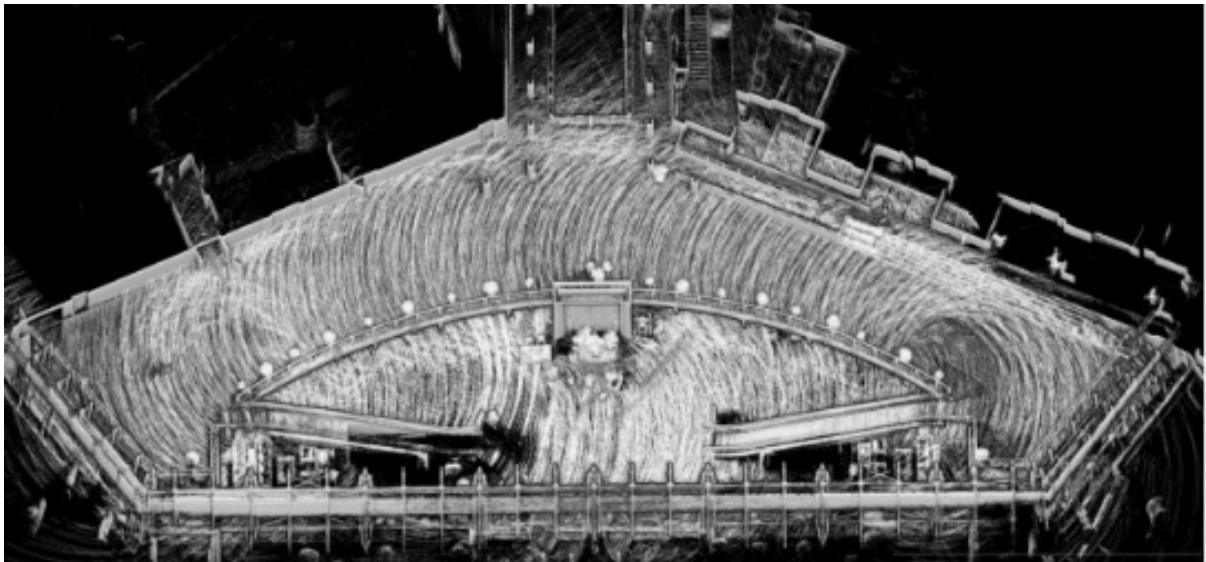
Hotel

Conference Room
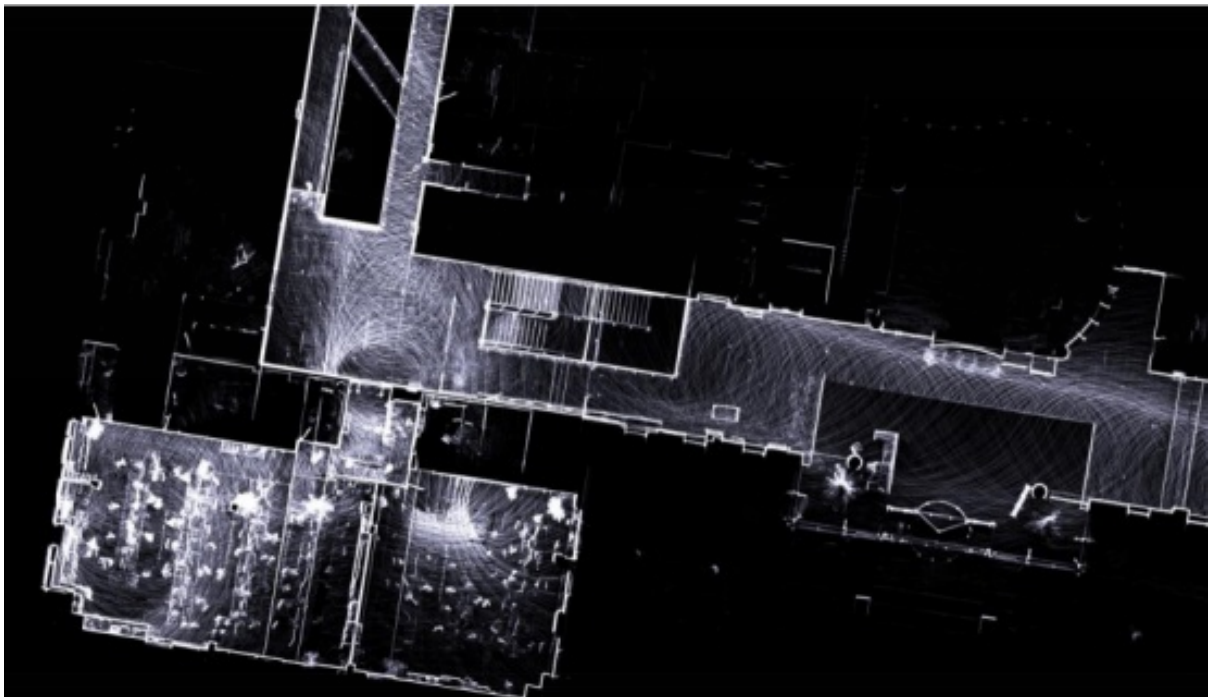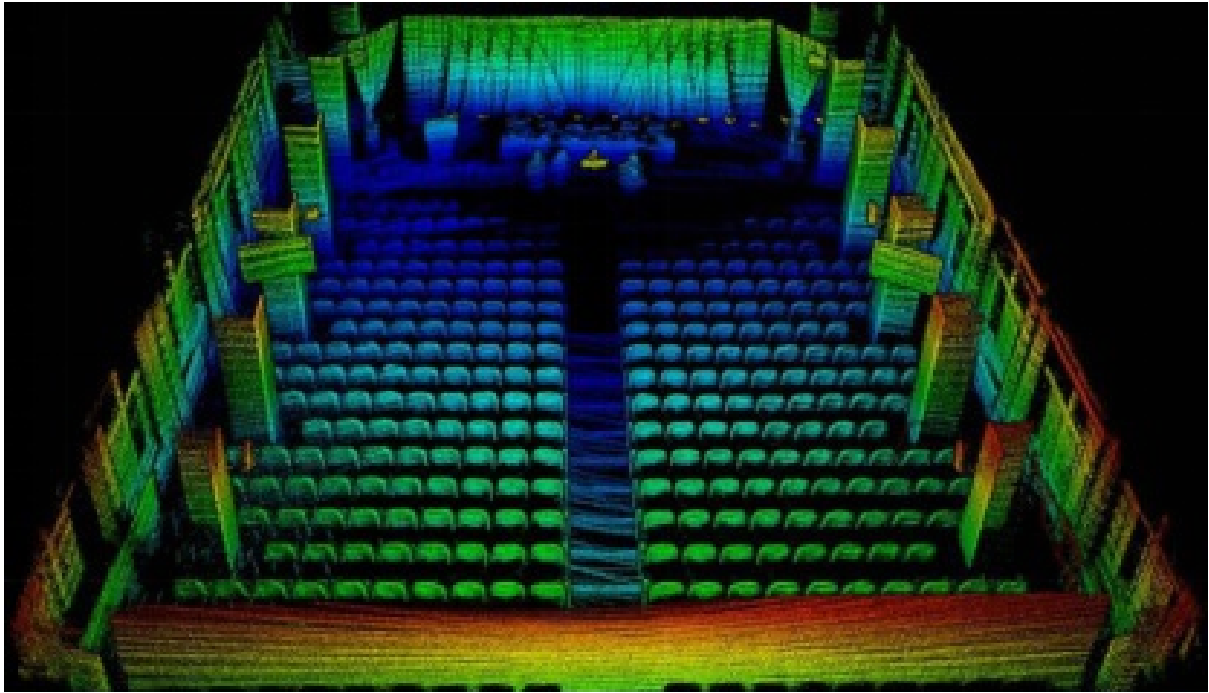
Office

Auditorium
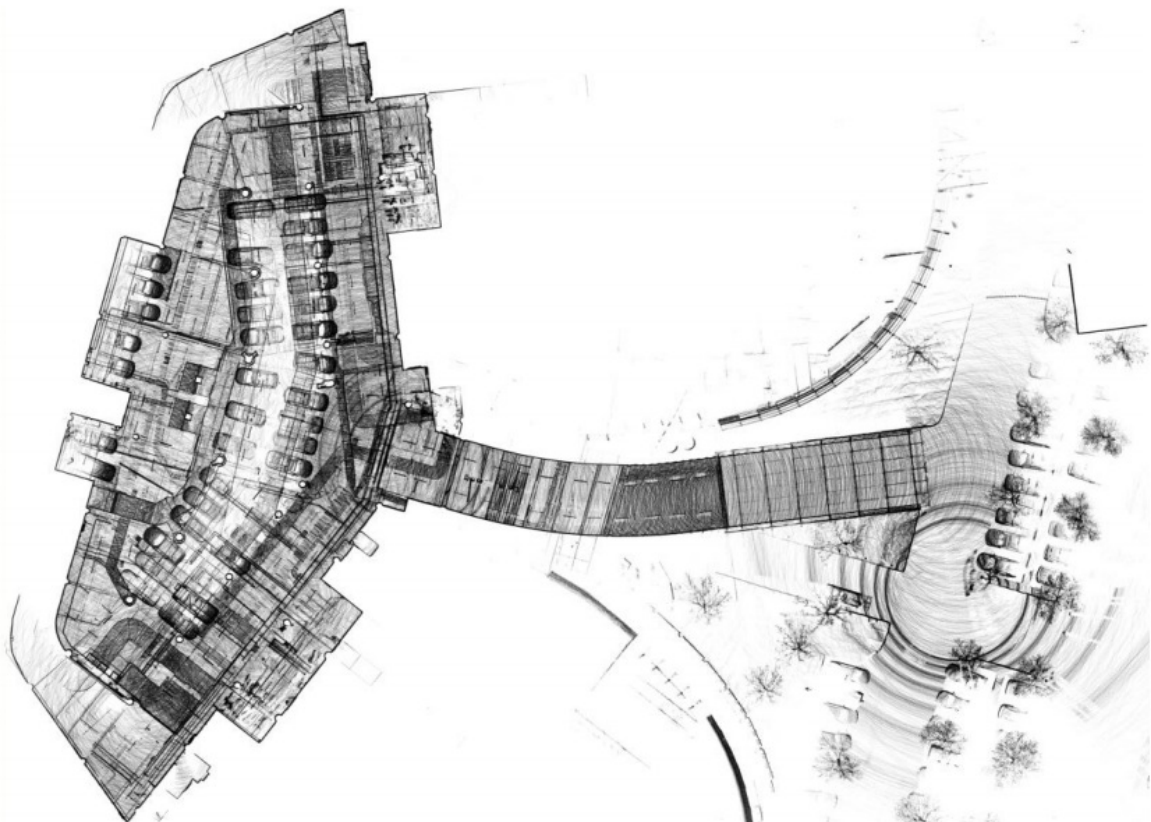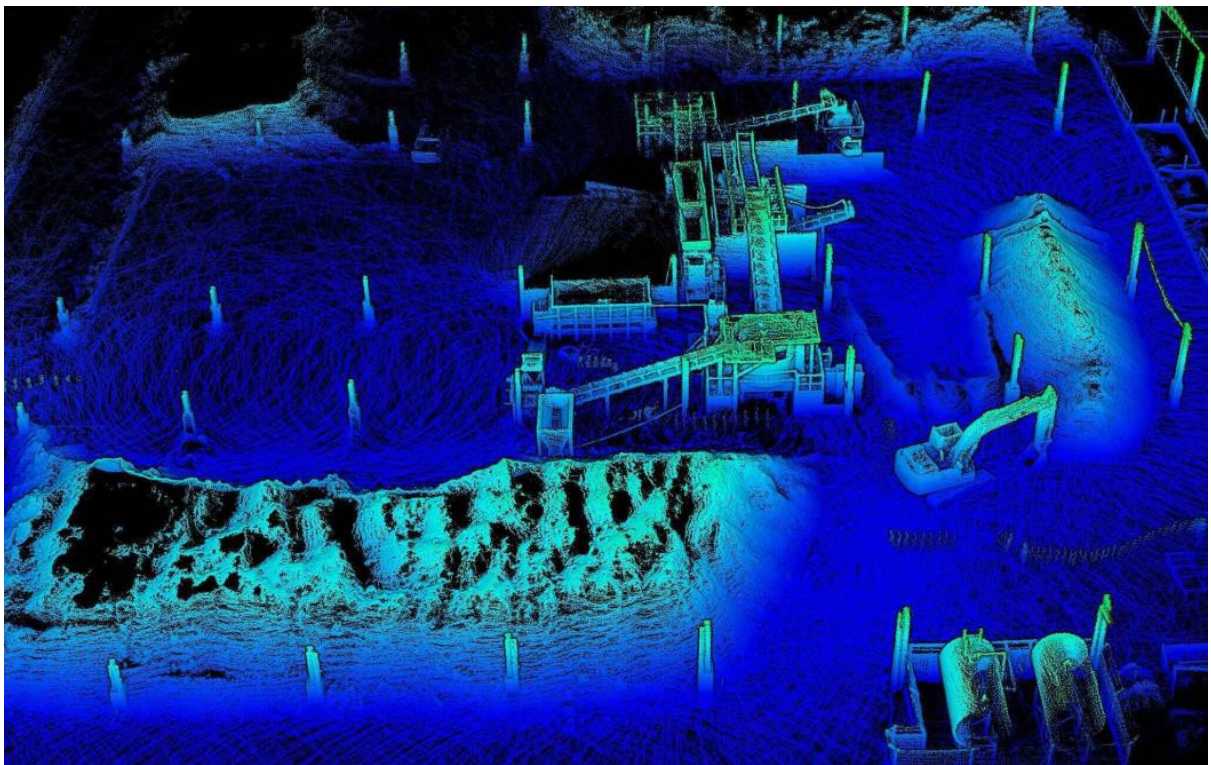

Parking Lot and Underground Parking Garage

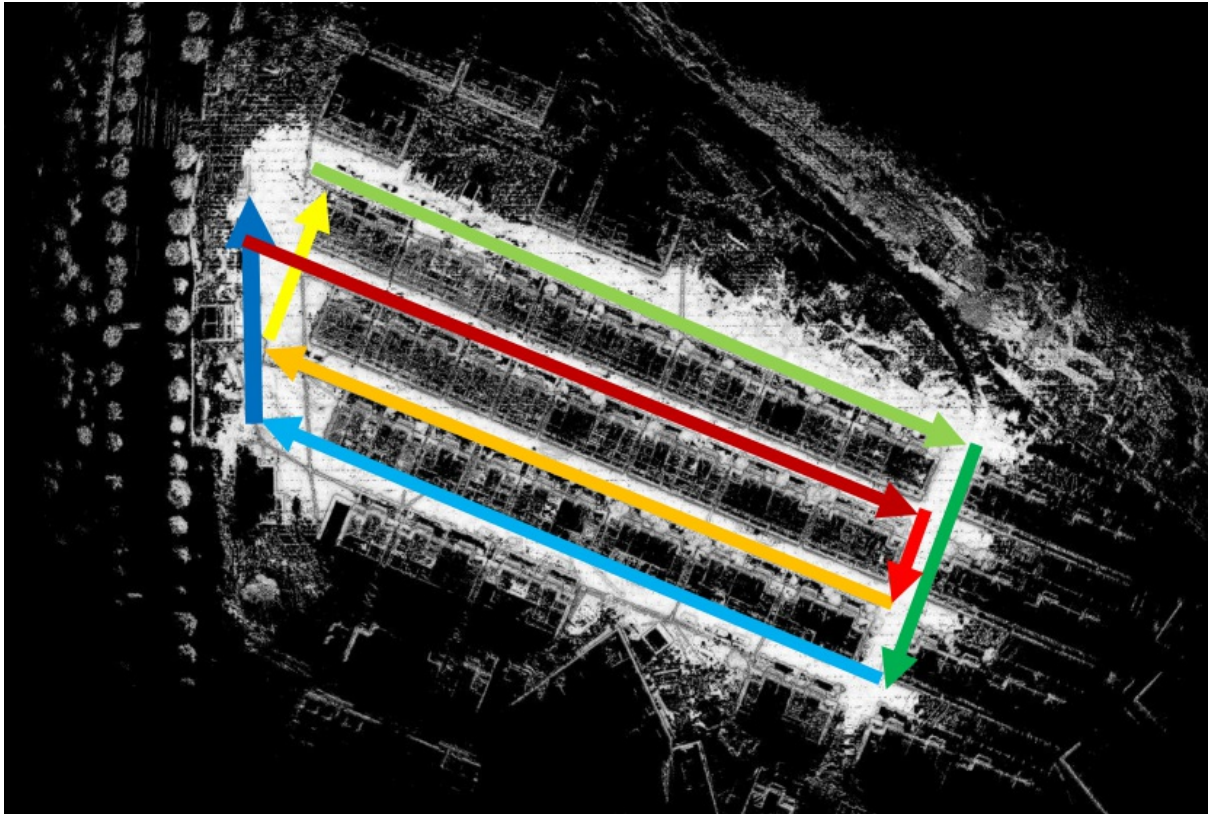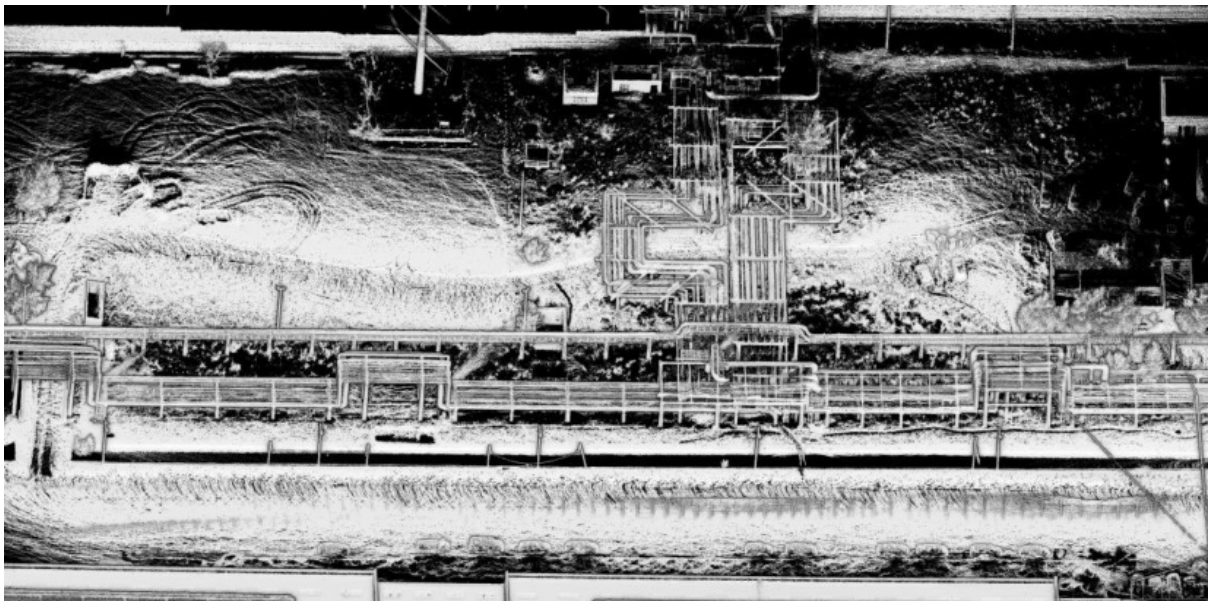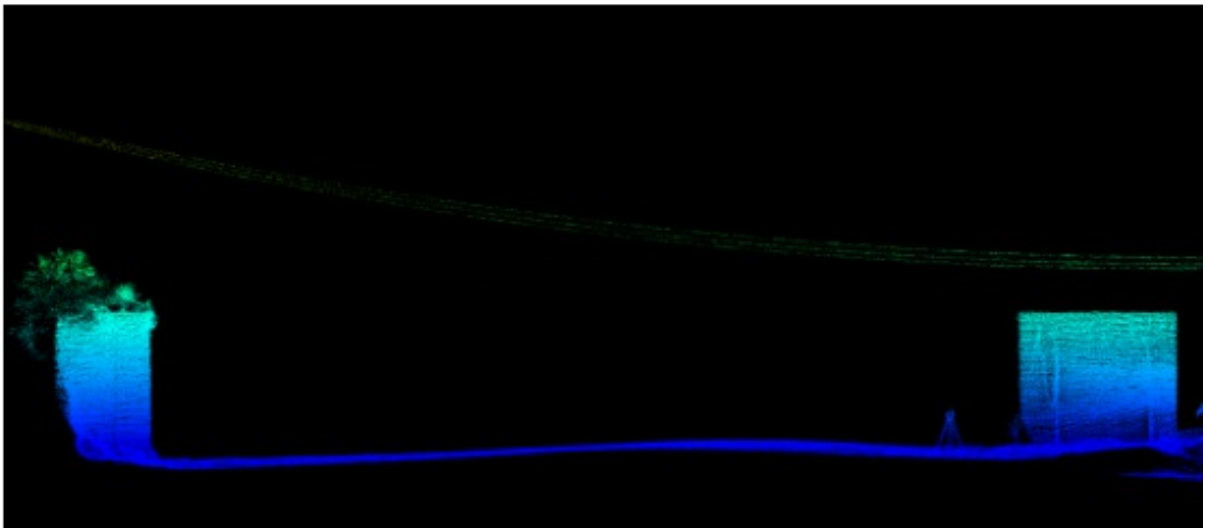Parking Lot and Underground Parking Garage
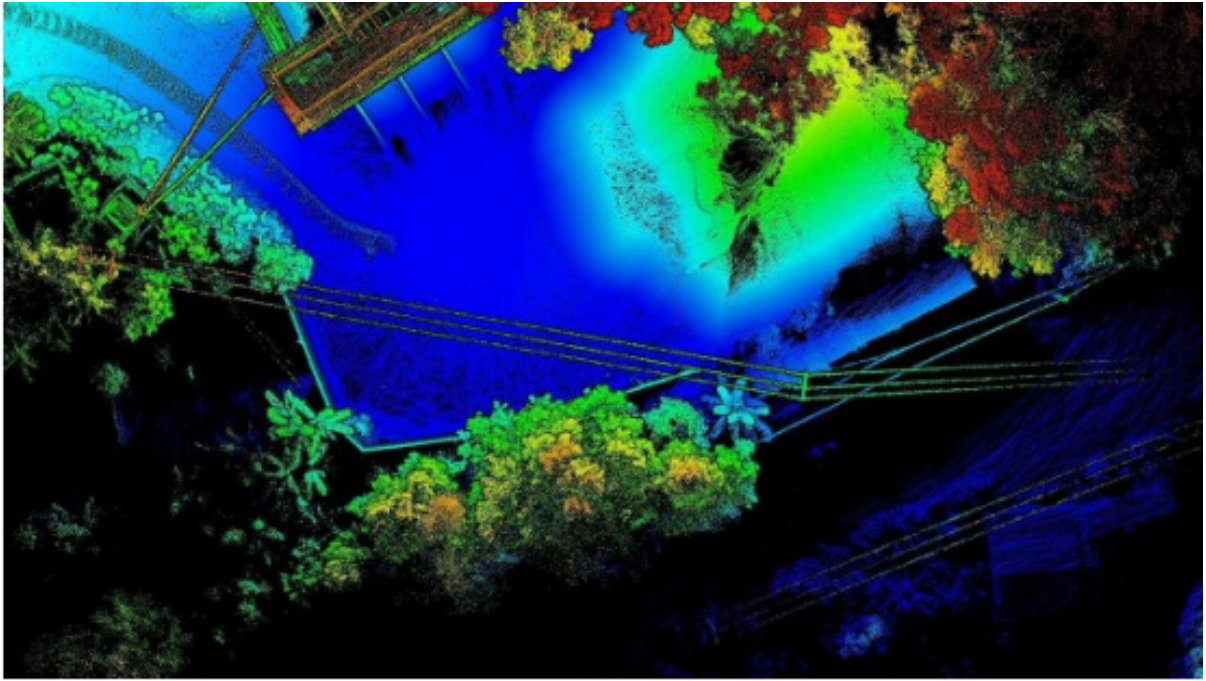

Office Buildings

Forestland

Sand barge

Construction site

Building Foundation

Pipelines

Powerlines